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WILDBOLZ (T.). **Über die Orientierung des Apfelwicklers bei der Eiablage.** [On the orientation of *Cydia pomonella* during oviposition.]—*Mitt. schweiz. ent. Ges.* **31** pt. 1 pp. 25–34, 3 figs., 10 refs. Zürich, 1958.

In ovipositing on apple, *Cydia pomonella* (L.) lays most of its eggs on smooth surfaces close to the fruits, chiefly leaves and twigs, or, later, on the ripening fruits themselves, and experiments were carried out in Switzerland in 1957 on the stimuli responsible for this choice of sites. A young tree caged in the field was used, all fruits being first removed from it. In the first experiment, stored apples were affixed to one leading shoot and glass balls of comparable size to another, and two others were left bare. Ten pairs of freshly emerged adults were introduced on 13th June, and the numbers of eggs deposited on the four shoots within six days were 205, 28, 57 and 26, respectively. Similarly, 80 eggs were laid on a fruiting shoot to which was affixed a twig bearing two young apples, 12 on one bearing a bait-jar of fruit juice, and 10 and 2 on two with no added attractant. In the second experiment, 156 eggs were laid by 20 females on 20th–23rd June on a leading shoot to which were affixed two stored apples in a filter-paper bag, and fewer than 40 on untreated leading shoots or on a shoot bearing waxed glass balls in one series of tests, and only four were laid on one of three untreated fruiting shoots and none on the remainder or on a shoot bearing two young apples in a thick gauze bag in another. The olfactory attractiveness of the fruits was tested in the third and fourth experiments by means of a glass cylinder, about 20 in. long and 3·5 in. in diameter, having three apples in the closed end and the open end covered with thin gauze. The cylinder was placed so that the end in which the apples were visible was against one of the leading shoots of the tree, and the open end, from which the odour emerged, against another. The third experiment was begun on 23rd June, no further adults having been introduced into the tent; the numbers of eggs three days later were 74 on the shoot with the olfactory stimulus, 42 on that with the visual stimulus, and 31 and 16 on shoots with no added attractant. In the fourth experiment, between 27th June and 1st July, 20 more pairs of adults were introduced into the cage and the position of the cylinder was reversed. The corresponding numbers of eggs laid were 90, 18, 27 and 19.

It is concluded that the odour of the fruits is the determining factor in the choice of oviposition sites. Attempts to identify the chemical components responsible failed, but it was found that attractiveness could be readily overcome by the use of certain repellents. Fruits treated with parathion at double the normal concentration showed no loss of attractiveness.

Oviposition occurred throughout the day, and not only in the evening, though flight was most active then; it was inhibited by mid-day shade temperatures exceeding 30°C. [86°F.]. An examination of infested trees in four localities showed a direct relation between the size of the apple crop and that of the larval population.

BAGGIOLINI (M.). **Étude des possibilités de coordination de la lutte chimique et biologique contre** *Cacoecia rosana* **avec le concours de** *Trichogramma cacoeciae*.—*Mitt. schweiz. ent. Ges.* **31** pt. 1 pp. 35–44, 6 figs., 4 refs. Zürich, 1958.

Fluctuations in populations of *Archips* (*Cacoecia*) *rosanus* (L.) and of its egg-parasite, *Trichogramma cacoeciae* Marchal, were studied in 1954–58 in an apple orchard in the Swiss canton of Vaud. Control was applied without the use of contact insecticides in one plot in 1955, and the whole orchard was

treated with a contact insecticide in 1956 and 1957 before the flower buds opened but after the adults of the overwintering generation of the parasite had laid their eggs in those of the Tortricid [*cf. R.A.E.*, A **46** 293], so that parasite survival was not prejudiced. Counts were made late in each winter of the numbers of egg-masses of *A. rosanus* present on 16 trees in the plot; the total fell from 720 in early 1955 to 202 in 1956, 67 in 1957 and 1 in 1958, and, of these, 16·11, 43·06, 49·25 and 100 per cent., respectively, were parasitised by *T. cacoeciae*. The results in 1958, being based on a single egg-mass, were considered insufficient for comparative purposes. The observation area was therefore extended, and 59 per cent. of 21 egg-masses were found to be parasitised. A more detailed assessment was carried out on six trees in the summers of 1955–57, and showed that 31·1, 32·2 and 44·5 per cent. of the eggs in the masses were parasitised by the two generations of *T. cacoeciae* in the respective years. The percentage for 1955 was much higher than elsewhere in the orchard, where it was only 11. The total numbers of eggs on these trees decreased from 3,604 in 1955 to 1,408 in 1956 and 801 in 1957, when two of the six trees were uninfested, and the percentages that hatched were 60, 50 and 15.

The results were confirmed by observations in another plot, in which about 80 per cent. of the fruits were destroyed by *A. rosanus* and in which fewer than 11·8 per cent. of the eggs were parasitised in 1955. Control was applied in 1956 and 1957 in the same way as in the rest of the orchard, and parasitism of the eggs increased to 54 and 73 per cent. in the two years, respectively. At the same time, the numbers of larvae on the sample trees and (in brackets) the percentage hatch decreased from 2,364 (75) in 1955 to 713 (33) in 1956 and 548 (21) in 1957, when damage by *A. rosanus* was negligible.

The harm resulting from the indiscriminate application of insecticides is exemplified by experience in an orchard in Valais, in which treatment was generally applied in late March, while females of the overwintering generation of *T. cacoeciae* were ovipositing. Only 10·4 per cent. of the egg-masses were parasitised in 1957, and the percentage of eggs parasitised was less than 3.

Quednau (W.). **Über den Einfluss von Temperatur und Luftfeuchtigkeit auf den Eiparasiten** *Trichogramma cacoeciae* **Marchal. (Eine biometrische Studie.)** [On the influence of temperature and air humidity on the egg parasite *T. cacoeciae*. (A biometric study.)]—*Mitt. biol. Bundesanst. Berl.* pt. 90, 63 pp., 18 figs., 47 refs. Berlin, 1957. (With a summary in English.)

The eggs used as hosts in the author's study of the effects of temperature and relative humidity on the development and fecundity of *Trichogramma cacoeciae* Marchal, the results of which are recorded in detail, were chiefly those of *Anagasta* (*Ephestia*) *kühniella* (Zell.), *Galleria mellonella* (L.) and *Cimex lectularius* L. The parasite reproduces parthenogenetically [*cf. R.A.E.*, A **46** 399] and is stated to develop only in fresh eggs of its various hosts [but *cf.* **46** 293]. Eggs of *Cimex* laid by females that had fed on human blood proved unsuitable, as no adult parasites developed in them; the bed-bugs were therefore allowed to engorge on guineapigs. Eggs of *Anagasta* could be stored at 0°C. [32°F.], and those of the other hosts at 5°C. [41°F.], for 20 days without ill effects. Eggs of *Anagasta* that had been killed by exposure to 60°C. [140°F.] for 15 minutes were as satisfactory for test purposes as living ones, but shrivelled in storage. The parasites were reared in small glass containers and by a mass rearing technique giving minimum periods of development.

Most tests were carried out with eggs of *A. kühniella*. At 80 per cent. relative humidity, development was completed in these at constant temperatures from 12 to 34°C. [53·6 to 93·2°F.], at which it averaged 51 and 9·5 days, respectively, and it was shortest (8·5 days) at 30–32°C. [86–89·6°F.]. The prepupae entered diapause at 11°C. [51·8°F.], and mortality was complete at 35°C. [95°F.]. The duration of development at the various temperatures was better expressed by Janisch's catenary curve [**14** 501] than by Blunck's hyperbola [**13** 389]. Development was slower in eggs of *Galleria* and *Cimex*. It ranged from 60 days at 13°C. [55·4°F.] to 9·5 days at 30–33°C. [86–91·4°F.] in *Galleria* and from 63 days at 12°C. to 9 at 30–31°C. [86–87·8°F.] and 9·5 at 32°C. in *Cimex*, the prepupae entering diapause at lower temperatures, and showed no relation to the thickness of the chorion of the eggs of the various host species. Mortality of the parasite eggs and larvae was probably low and that from the prepupal stage onwards, at 80 per cent. relative humidity, reached minima of almost nil at 25°C. [77°F.] in *Anagasta*, about 6 per cent. at 27°C. [80·6°F.] in *Galleria*, and 50 per cent. at 27°C. in *Cimex*. The adults were very active at 30–35°C. and crawled and sprang at 20–22°C. [68–71·6°F.], but were more or less inactive at 13–14°C. [55·4–57·2°F.]. A temperature of about 29°C. [84·2°F.] was the most suitable. Most progeny were produced at temperatures of 20–30°C., the maximum being about 109–112 per female at 25–27°C., at which the adults lived for about 22 days, as compared with about 40 days at 10–15°C. [50–59°F.]. Constant relative humidity had little effect on the duration of development, especially at favourable temperatures, but increased mortality as it rose above or fell below 80 per cent. and decreased fecundity when it was very high or low.

Development at varying temperatures was also studied, and a new method of calculating its theoretical duration developed. Instead of the thermal constant of Blunck [*cf.* **23** 296], which proved insufficiently accurate, the number of days (9·5) required for development at 27°C. was taken as a basis, and the fraction obtained by dividing this by the number of days required at another temperature was regarded as the proportion of it completed in a day at that temperature. Thus, for 15°C., at which development lasted 33 days, the fraction was about 0·29. By summing successive daily fractions until a total of 9·5 was reached, the number of days required for development at varying temperatures was obtained. The process was also applied to successive periods of 12 hours, which gave a more accurate analysis, and the results were found to agree very well with those obtained empirically for various series of alternating daily temperatures. When the daily temperature alternated between 27 and 15, 27 and 10, or 15 and 10°C., development in eggs of *Anagasta* required 15, 17 and 46 days, respectively (with mortality of 4, 5 and 20 per cent.), and when it alternated between 27 and 5°C. [41°F.], 27 and 0°C., and 27 and 6°C. [42·8°F.], 19 days were required in all cases (with mortality of 6 per cent.), but the method did not work well for temperatures below 12°C. Change in colour of prepupae and ultimately of adults occurred when the prepupae were subjected to low temperatures early in their development; in the two series of alternating temperatures mentioned, the colour of the emerging adults was dark (except for alternation between 27 and 15°C., when it was yellow) in the first and yellow in the second. In a more complicated test, rearing was carried out at 15°C., with a period of eight hours at 27°C. every day, to simulate good weather, or every four days, to simulate bad weather. Development lasted 18 and 30 days, respectively, mortality was 4 and 6 per cent., and the numbers of progeny and (in brackets) the duration of adult life in days were 66 (30) and 19 (36) for adults kept at the variable temperatures and 85 (22) and 67 (18) for those transferred to 27°C.

In a test carried out under simulated winter conditions and a relative humidity of 80 per cent., to investigate the possibilities of overwintering, eggs of *Anagasta* containing prepupae of *T. cacoeciae* were kept at 27°C. and removed after five days for various periods to temperatures ranging from −6 to 10°C. [21·2 to 50°F.], after which they were returned to 27°C. Development was completed in periods that ranged from 14 to 52 days when the insects were exposed to 10°C. for periods ranging from 5 to 50 days, after which emergence of survivors was complete, from 14 to 109 days when they were exposed to 5°C. for periods ranging from 5 to 100 days, from 14 to 60 days when they were exposed to 0°C. for periods ranging from 5 to 50 days, and from 14 to 32 days when they were exposed to −6°C. for periods ranging from 5 to 20 days, longer exposures at the last three temperatures causing complete mortality. Eggs of *Anagasta* containing parasite eggs were also kept at 27°C. and transferred to the lower temperatures after one day. Some of the parasites reached the prepupal stage, and these then entered diapause, development being completed in 208 days when cooling lasted 200 days at 10°C. Prepupae taken in the field after 100 days in diapause and exposed to −6°C. for 200 days completed development in 308 days. In a similar test at 40 per cent. relative humidity, in which eggs of *Galleria* containing prepupae were kept at 27°C. and transferred to lower temperatures after 5 days, development was completed in 75 days when cooling lasted 75 days at 10°C. and in 115 days when it lasted 100 days at 8°C. [46·4°F.] but mortality was very high. There was little development and early death at temperatures under 5°C. Further tests, in which *T. cacoeciae* was reared in *Galleria* and *Anagasta* at 80 and 40 per cent. relative humidity, respectively, confirmed that exposure to cold led to high mortality if the parasites had not reached the prepupal stage. Prepupae in diapause could be kept for almost a year at low temperatures.

Field observations on the annual cycle of development were carried out for a year from 2nd May 1955. Parasitised eggs were exposed in the glass containers, which afforded some protection from cold, or among leaves, and 5–6 generations developed, according to host, before autumn. Overwintering occurred successfully in eggs parasitised at the end of September, in which the prepupal stage was reached at the time of the fall in temperature in October and the prepupae entered diapause, but not in those parasitised earlier or later, in which this stage was passed or not reached. Laboratory tests showed that the fecundity of the resulting females was little affected by prolonged exposure to cold when this occurred during the diapause. Newly laid host eggs are usually not available when the first parasites emerge in spring, and individuals reared in *Galleria* at 27°C. and kept without host eggs for 5, 10, 15 or 30 days, at 27, 27, 15 and 15°C., respectively, laid about 92, 40, 46 and 17 eggs, respectively, in *Anagasta* at 27°C. and 80 per cent. relative humidity and lived 21, 13, 17 and 8 days. Janisch's method for predicting the length of life of insects under changing temperatures [*cf.* **18** 241] could be fully applied only to the adults.

To test the effect of variable relative humidities on mortality at optimum temperature, the parasites were reared for six days at 82, 35 and 0 per cent. relative humidity and then at one or other of the same three humidities. Mortality usually increased with transfer to a lower humidity and decreased with transfer to a higher one. Parasites reared for 60 days at 12°C. had by the end of that time given rise to adults or died when the relative humidity was 80 per cent. but had entered diapause when it was 40 or 0 per cent. When the survivors were transferred to 27°C., all died in 10 days at 40 per cent. relative humidity, but some adults emerged at 80 per cent. Those that entered diapause at 0 per cent. relative humidity all died when transferred to 27°C. and 80 per cent. humidity.

Bouček (Z.). *Plastotorymus amygdali*, **n.sp., eine neue Torymide (Hym. Chalc.) aus Mandelkernen des Nahen Ostens.** [*P. amygdali*, sp.n., a new Torymid from almonds in the Near East.]—*Acta ent. Mus. nat. Pragae* **32** no. 529 pp. 583–586, 1 fig., 3 refs. Prague, 1958.

Plastotorymus amygdali, sp. n., is described from adults of both sexes reared in Jordan from almonds infested by *Eurytoma amygdali* End. It was almost certainly a primary parasite of the latter, but possibly also feeds on the kernels themselves, as has been reported for another Torymid parasite of *E. amygdali* [*R.A.E.*, A **24** 342–343].

Fernández Valiela (M. V.). **Plant pests and diseases of economic importance in the Paraná Delta, Argentina.**—*FAO Plant Prot. Bull.* **7** no. 10 pp. 129–133, 1 map. Rome, 1959.

The author reviews the crops grown in the Paraná delta, in Argentina, and the principal pests and diseases of fruit and forest trees there.

Lal (K. B.). **Plant protection in India.**—*FAO Plant Prot. Bull.* **7** no. 10 pp. 134–137. Rome, 1959.

The organisation of plant protection in India, which has since 1946 been the responsibility of the Directorate of Plant Protection, Quarantine and Storage, is described, and work on the control of insects and other pests of plants there since about the beginning of the present century is reviewed.

Subbiah (M. S.) & Mahadevan (V.). *Vespa cincta* **Fabr.—a predator of the hive bees and its control.**—*Indian J. vet. Sci.* **27** (1957) pt. 4 pp. 153–154, 3 refs. New Delhi [1958].

In southern India, the Indian honey bee, *Apis indica* F., is attacked by *Vespa tropica* (L.) (*cincta* F.), which occurs mostly in the plains, and by *V. tropica* var. *haematodes* Beq., which was collected in the Nilgiri hills at an altitude of 2,500 ft. At Coimbatore, the wasps frequent the baseboards of the hives on cool cloudy mornings from June to December and attack the workers as they pass in and out. Breeding activity is low among the bees at this season, and the attack further weakens the colony, so that the bees either desert the hive or perish. Methods of controlling the wasps comprise the fumigation of their nests with calcium cyanide, the hydrogen cyanide evolved giving instant and complete mortality, or, if the nests are inaccessible, the capture in hand nets and destruction of the wasps at the hives. A spray of 0·05 per cent. parathion directed towards the nests after sunset was not immediately effective, and wasps were still active 3–4 days later. When the body of the hive was pushed forward to the front of the baseboard, leaving no space for either the bees or the wasps to alight, the bees were not attacked, and this measure is accordingly recommended, in addition to the destruction of the nests.

Subbiah (M. S.), Mahadevan (V.) & Janakiraman (R.). **A note on the occurrence of an Arachnid**—*Ellingsenius indicus* **Chamberlin—infesting bee hives in South India.**—*Indian J. vet. Sci.* **27** (1957) pt. 4 pp. 155–156, 1 fig. New Delhi [1958].

Chelifers subsequently identified as *Ellingsenius indicus* Chamberlin were found in hives of honey bees [*Apis indica* F.], among dirt and débris on the baseboards, and clinging to the workers, at two places at altitudes of 6,500 and 2,500 ft. in the Nilgiri hills, in southern India. They occurred in large

numbers on bees of the hill variety, and also occasionally on those of the plain variety at Coimbatore, at an altitude of 1,200 ft. The extent of the harm done by them is not known, but their weight hinders foraging by the bees, so that general activities are reduced and the hive is weakened; colonies at the higher altitude are sometimes completely destroyed. The source of the infestation is unknown, but chelifers appear in a few days in hives established from wild bees, although the latter and their combs are uninfested. In the laboratory, the chelifers survived for ten days in empty tubes and for 2–6 days in cages provided daily with débris and bees, but failed to breed. Of ten introduced into a working colony of bees, two lived for 12–13 weeks and the others failed to survive. The chelifers did not thrive when fed on young larvae of *Galleria mellonella* (L.) or on eggs of honey bees.

Bhat (M. V.), Patel (G. A.) & Gokavi (M. A.). **Investigations on paddy gall-midge (*Pachydiplosis oryzae* W. M.). Part II. Varietal resistance to gall midge.**—*Indian J. Ent.* **20** pt. 1 pp. 21–26, 3 refs. New Delhi, 1958.

In this second paper of a series on the infestation of rice by *Pachydiplosis oryzae* (Wood-Mason) in the North Kanara district of India [*cf. R.A.E.*, A **47** 386], the results are given of preliminary row tests in 1952–55 on the relative susceptibility to infestation, as evidenced by silvering of the shoots, of 146 varieties of rice. It was found that one very late variety, though yielding 20 per cent. less than improved strains, was the most resistant; when caged plants of this variety were artificially infested with eggs and larvae in pot tests, they showed averages of 45 tillers per pot and 2·9 per cent. silvered shoots, as compared with 38–41 tillers and 14·9–17·3 per cent. silvered shoots on others. It is suggested that this variety should be used in breeding rice for resistance to *P. oryzae*, and that the use of resistant varieties would be more acceptable to growers than the application of insecticides.

Beri (Y. P.). **Field experiments on the cabbage pest control.**—*Indian J. Ent.* **20** pt. 1 pp. 63–66, 1 fig., 2 refs. New Delhi, 1958.

In view of reports in Queensland that the recommended application of a dust mixture of 2 per cent. DDT and 0·26 per cent. γ BHC had failed to control *Plutella maculipennis* (Curt.) and *Pieris rapae* (L.) on cabbage, plot tests to compare the dust with sprays of dieldrin and endrin were carried out in 1954. Initial applications were made on 19th August, when the plants were 3 in. high and infestation by both insects was light, and further applications were made on 3rd and 17th September and 8th October. Injury to the cabbages at harvest was assessed by a method of rating, and the rating values per plot of eight plants were 3·6–16·6, 0–4·2, 10·2 and 21·2 on plants sprayed with 0·1–0·025 per cent. dieldrin, 0·05–0·0125 per cent. endrin and 0·1 per cent. DDT with 0·03 per cent. BHC and dusted with the recommended mixture, respectively, as compared with 40 for no treatment. In a second series of tests, in which endrin sprays were compared with the recommended dust mixture and the plots were treated on 15th and 30th October, 14th November and 14th December, the rating values were 3·22, 12·5 and 11·75 for 0·5, 0·025 and 0·0125 per cent. endrin, respectively, as compared with 22 for the mixture and 100 for no treatment, but the treated plots showed no significant differences from one another in numbers of marketable heads, which were 19–20, as compared with 0 for no treatment.

Hukusima (S.). **Ecological studies on the peach fruit moth, *Carposina niponensis* Walsingham. I. On the diurnal rhythm of adult.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **18** pp. 55–60, 2 figs., 10 refs. Tokyo, 1953. **II. The temperature preference of adult.** [*In Japanese.*]—*Oyō-Kontyu* **8** no. 4 pp. 149–151, 3 figs., 7 refs. Tokyo, 1953. **III. Relations of environmental factors to the development of larval and pupal stages and activity of larva.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **19** pp. 124–130, 5 figs., 20 refs. Tokyo, 1954. **IV. On the oviposition preference of the peach fruit moth.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 1–10, 5 figs., 32 refs. Kyoto, 1957. (With summaries in English.)

Carposina sasakii Mats. (*niponensis* Wlsm.) has long been known as a pest of apples, peaches and other tree fruits in Japan [*cf. R.A.E.*, A **28** 628] and occurs throughout the fruit-growing regions of Hokkaido and Honshu. Its life-history has been well studied [*cf.* **16** 483; **19** 602; **24** 628], but little information is available on its ecology. Investigations were therefore carried out on apple in 1952–55 at Hirosaki, Aomori prefecture. In the first two parts of this paper, it is stated that the activity of the adults, with regard to both flight and oviposition, is greatest at night in fine weather. Such activity is apparently regulated mainly by the air temperature, flight reaching its maximum at about 20°C. [68°F.] and decreasing rapidly above 25°C. [77°F.] and below 18°C. [64·4°F.]. A preference for temperatures of 20–23°C. [68–73·4°F.] was shown by adults subjected to a gradient of 15–60°C. [59–140°F.]. Adults sheltered beneath leaves during daylight, but were active during the day in cloudy weather when temperatures were comparatively low. Changes in relative humidity, light intensity and wind velocity had little effect on activity. The rate of larval and pupal development, which is considered in the third part, was also dependent on temperature. Development of overwintered larvae and pupae was most rapid at about 30°C. [86°F.], but mortality was least at 25°C. The temperature zone preferred by mature larvae, which enter the soil to pupate, was 22·5–25°C. [72·5–77°F.], and mortality in the soil was increased by high soil moisture. Young larvae were more restricted in their temperature requirements, but did not suffer high mortality until the temperature exceeded 30°C.

From comparative oviposition tests on fruits, glass balls, and glass balls wrapped in cotton, which are described in the fourth part, it was evident that females were attracted most strongly to hairy surfaces. In one series of tests, the numbers of eggs laid on peaches, quinces, pears, wrapped balls, apples and unwrapped balls averaged 18·44, 10·22, 5·44, 1·11, 1·11 and 0·89, respectively, and the more hairy parts of each fruit were generally more attractive than the others. In a test with apples of six varieties, there were considerable differences between the numbers of eggs laid, which were correlated directly with the density of hairs on the fruits. Further tests indicated that the stimulus responsible for the selection of hairy surfaces was largely tactile.

Shibatsuji (T.). **Ecological investigations on the soy bean root miner, *Melanagromyza* sp. V. Occurrence of the soy bean root miner on the soy bean plant grown as the catch-crop with wheat.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 24–29, 6 figs., 6 refs. Kyoto, 1957. (With a summary in English.)

In investigations in Akita prefecture, Japan, on the infestation of soy beans by *Melanagromyza* sp., which mines in the roots, the degree of

infestation in a field devoted solely to this crop was found to be similar to that in a field in which soy beans were grown as a catch-crop between rows of wheat. The number of adults collected in the first field during the peak emergence period in early June was about twice that caught in the second, in which adult activity was reduced by increased shade and lower air temperatures, except on hot and windy days. Nevertheless, the percentages of eggs that hatched were 35·5–56 and 56·8–81·4, respectively. Differences were also noted in the oviposition sites. Eggs were laid on the hypocotyl between 1·2 cm. below the soil surface and 3 cm. above it in the first field and between 0·6 cm. below the surface and 6 cm. above it (including the cotyledons) in the second; most eggs were laid at the soil surface in both fields.

Okamoto (D.). **Relation between the cultivating practices of rice plant and the injury caused by the rice stem maggot, *Chlorops oryzae* Matsumura.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 33–45, 4 graphs, 15 refs. Kyoto, 1957. (With a summary in English.)

Field investigations on the effects of cultural practices on the incidence of *Chlorops oryzae* Mats. on rice were conducted in 1941–54 in Hyogo prefecture, Japan, where the Chloropid has three generations a year [*cf. R.A.E.*, A **46** 475]. Only the first two generations are of importance. The first usually has little effect on yield, though cultural practices that favour it result in increased injury by the second, and cultural methods that decrease the damage are best applied against the second generation. There is a direct relation between the number of injured stems and the number of eggs laid, which is itself dependent on the number of adults present, but the actual degree of injury was not so directly linked [*cf.* **39** 300]. Cultural factors that were found to increase the damage caused by the first generation were early sowing [*cf.* **27** 555; **29** 173], covering the seedbed with oiled paper, high sowing rates, early transplanting, high planting densities, and shallow planting. The converse of these (with the exception of the last) increased the injury caused by the second generation, as also did cool as compared with warm irrigation water, high rates of fertiliser or green manure, and fertiliser placement at all levels rather than on the surface. Adults of the first generation preferred tall and dense plants, whereas those of the second generation preferred plants that had been well fertilised and had dark foliage.

Tamura (I.), Iwata (T.) & Kishino (K.). **Ecological studies on the occurrence of the rice stem maggot. I. On the development and mortality of overwintering larvae of the rice stem maggot, *Chlorops oryzae* Matsumura, at Takada province.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 45–51, 2 graphs, 5 refs. Kyoto, 1957. (With a summary in English.)

Chlorops oryzae Mats., which infests rice during the summer, overwinters on wild grasses [*cf. R.A.E.*, A **24** 695]. The development and mortality of larvae of the overwintering generation were studied in 1954–56 in Niigata prefecture, Japan, where snow persists for 2–3 months and *Alopecurus aequalis* (*fulvus*) is the usual winter food-plant. These larvae hatch in October and develop slowly until December, when they hibernate, still in the first instar. They resume development shortly after the snow disappears. Adult emergence in spring is therefore regulated by the date at which the snow melts, and the later that occurs the shorter is the period before emergence. Larval mortality is low under the snow cover, and the severity of the winter is therefore not a dominant factor in the size of the adult

population. Mortality increases with the resumption of larval development and reaches its maximum just before the third-instar larvae move to their pupation sites on the stems and lower leaf sheaths.

Ishii (T.), Ichinose (T.) & Kojima (K.). **On the resistibility of the cabbage armyworm, *Barathra brassicae* L. to BHC emulsion and the recovery from the toxic symptoms.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 63–69, 3 graphs, 7 refs. Kyoto, 1957. (With a summary in English.)

In laboratory experiments in Tokyo, larvae of *Mamestra* (*Barathra*) *brassicae* (L.) were dipped in an emulsified solution of γ BHC in acetone with the addition of an alkyl ester of polyoxyethylene. The medial lethal concentrations for larvae in the six instars were 0·00048, 0·00099, 0·0086, 0·086, 0·34 and 0·83 per cent. (w/v), respectively. The LD50 by injection for sixth-instar larvae was 40·256 μg. per 1·13 g. body weight. BHC caused death more rapidly than did DDT, but considerable numbers of BHC-treated larvae recovered. Symptoms appeared more rapidly and disappeared more slowly as the BHC dose was increased. Thus, larvae into which a dose near the LD50 was injected showed symptoms within five minutes and many began to recover 1–3 hours later, whereas the LD10 merely caused a cessation of feeding, which was resumed after an hour. The occurrence of symptoms was not directly related to the amount of γ BHC in the body, for the quantities found in sixth-instar larvae remained fairly constant for two hours after injection and there was only a slight decrease after five hours.

Nomura (K.), Shibanuma (C.), Yamada (S.), Matsuba (M.) & Morita (S.). **Studies on the systemic insecticides. VI. Residual content and toxicity of schradan in relation to cotton aphid control.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 80–86, 1 graph, 17 refs. Kyoto, 1957. (With a summary in English.)

When a spray of 0·2 per cent. Pestox 3 (containing 55 per cent. schradan) was applied to egg-plants (*Solanum melongena*) in Japan, the schradan contents 0, 5, 10 and 20 days later were 66, 25, 4·5 and 3·7 parts per million in the leaves and 4·3, 1·3, 0·96 and 0·63 p.p.m. in the fruits, respectively. The lower contents in the fruits are explained by their rapid growth, since they increased in weight from 7·1 g. on the first day of the test to 65·7 g. 10 days later. When correction was made for this, the contents 1, 5 and 10 days after treatment were in the proportion of 1:0·94:2·22. The rate of schradan decomposition was therefore less in the fruits than in the leaves, but there was probably translocation from leaves to fruits. The percentage inhibition of human-blood cholinesterase decreased from 73 on the day of treatment to 38 after 10 days, and of rabbit-blood cholinesterase from 76 to 0. Mortality of *Aphis gossypii* Glov. in 48 hours, as determined by Abbott's formula [*cf. R.A.E.*, A **13** 331], was 69 per cent. on the day of treatment, 100 per cent. after 10 days and 0 after 20 days. These findings were substantiated by other field tests, in which control of aphids and mites reached its peak 10 days after treatment.

Koyama (N.). **Notes on the feeding habits of the larva of the potato lady beetle, *Epilachna vigintioctomaculata* Motsch., and its breeding.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 86–94, 6 figs., 46 refs. Kyoto, 1957. (With a summary in English.)

In feeding tests with larvae of *Epilachna vigintioctomaculata* Motsch. in Japan, complete development was obtained on potato, egg-plant [*Solanum*

melongena], black nightshade (*S. nigrum*), tomato, thorn-apple (*Datura tatula*), *Scopolia japonica*, boxthorn [*Lycium*], cucumber and Japanese pumpkin; cucurbits had previously been thought unsuitable [*cf. R.A.E.*, A 27 362]. Newly hatched larvae preferred the leaves of potato to those of any other plant. In the laboratory, adults fed on slices of potato tuber, and these and the leaves of some other plants were fed on by first-instar larvae. Fourth-instar larvae ate leaves of burdock (*Arctium lappa*) and thistle (*Cardus crispus*), but did not complete their development and preferred solanaceous plants. Volatile attractants are considered to be of less importance in the selection of food-plants by *Epilachna* than the structure of the leaf surface. Larvae were observed to feed on eggs and pupae of their own species, but such feeding sometimes caused the development of aberrant forms.

Sakai (S.) & Asuka (Y.). **Insect toxicological studies on the joint toxic action of insecticides. IV. On the carrier efficiency and joint toxic action of insecticidal solvents.**—*Botyu-Kagaku* **22** no. 1 pp. 113–138, 14 graphs, 32 refs. Kyoto, 1957. (With a summary in Japanese.)

The effectiveness of organic solvents in assisting the penetration of insect cuticle by insecticides is reviewed from the literature, and the results are given of investigations in Japan in which 58 such solvents in seven chemical groups were used with γ BHC (lindane). House-flies (*Musca domestica vicina* Macq.) 3–4 days old were exposed for 30 seconds in a dusting apparatus to a dust of 0·1 per cent. γ BHC with 1 or 2 per cent. solvent on a base of clay and talc (3:2) and observed for knockdown at intervals for 24 hours at 28°C. [82·4°F.], and parallel tests were carried out in which either γ BHC or the solvents were omitted from the dusts. The knockdown caused by γ BHC without solvents was 29·25 per cent. after an hour and 33·16 per cent. after 3–24 hours. The solvents themselves mostly had little knockdown action, and they varied considerably in their effectiveness in the complete dusts, some increasing knockdown appreciably and some being useless. Except for a few of high viscosity, including the glycols, they were more effective at 2 than at 1 per cent., and the best at 2 per cent., with (in brackets) the 18- and 24-hour knockdown percentages, were isobutyl alcohol (74·8 and 75·5), cyclohexanol (72·3 and 66·9), methyl isobutyl ketone (70·2 and 72·8), methylethyl ketone (68·9 and 65·5), chloroform (67·7 and 59·8), isoamyl acetate (67·1 and 67·2), tricresol (62·3 and 53·3), ethylene dichloride (61·5 and 58·7), n-butyl alcohol (55·6 and 55·1) and trichloroethylene (58·8 and 58·3). At 1 per cent., some of the solvents rendered the dusts less effective, methyl isobutyl ketone, for example, reducing the 24-hour knockdown to 15·5 per cent.

Other tests were carried out with crickets (*Acheta* (*Gryllus*) *mitratus* (Hagenbeck)), the tarsus of one of the hind legs of these being dipped for 30 seconds in solutions of 0·1 per cent. γ BHC in the various solvents and the time required for knockdown being noted. The solvents again affected the results, but their order of effectiveness was not the same as for the flies and varied with the sex of the cricket. The most effective, with (in brackets) the number of minutes required for knockdown, were benzene (1), methyl isobutyl ketone (4), aniline (4), isoamyl acetate (5), dioxane (7), n-hexane (11), cyclohexanol (19) and toluene (19) for males, and Velsicol AR-60 (methylnaphthalenes) (3), toluene (16), trichloroethylene (18), isoamyl acetate (18), dioxane (18), o-chlorotoluene (19) and solvent naphtha (20) for females. A few were very ineffective, the solution in ethyl cellosolve requiring 2,779 and 1,068 minutes for knockdown of males and females,

respectively, and that in benzyl alcohol requiring 1,970 minutes for females, though only 36 minutes for males.

In these tests, there was no regular relation between knockdown effectiveness and the boiling points of the various solvents or their solvent efficiencies for γ BHC, bees-wax or house-fly lipids, but there was some relation with surface tension and viscosity. It was not possible to determine whether there was any similar joint action between the solvents and γ BHC.

Koizumi (K.). **Notes on some Dipterous pests of economic plants in Japan.** [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 223–227, 3 figs., 20 refs. Kyoto, 1957. (With a summary in English.)

The Diptera recorded are *Microchrysa flaviventris* (Wied.), larvae of which were observed damaging young tobacco plants in Okayama prefecture, *Rivellia apicalis* Hend. and *R. basilaris* (Wied.), larvae of which feed in the root nodules of soy bean and cowpea, *Trypeta trifasciata* Shiraki, which mines the leaves of *Artemisia* and cultivated chrysanthemums, and *Melanagromyza websteri* (Mall.), which causes galls on the twigs of wild and cultivated *Wistaria* [*cf. R.A.E.*, A **4** 236] in Honshu and Shikoku. Notes on their bionomics are included.

Fisken (A. G.). **Factors affecting the spread of aphid-borne viruses in potato in eastern Scotland. I. Overwintering of potato aphids, particularly** *Myzus persicae* **(Sulzer).**—*Ann. appl. Biol.* **47** no. 2 pp. 264–273, 1 fig., 1 map, 19 refs. London, 1959. **II. Infestation of the potato crop by potato aphids, particularly** *Myzus persicae* **(Sulzer).**—*T.c.* pp. 274–286, 1 fig., 2 maps, 15 refs.

The following paragraphs are virtually the author's summaries of the two parts of this paper.

Three species of potato aphids, *Myzus persicae* (Sulz.), *Macrosiphum solanifolii* (Ashm.) (*euphorbiae*, auct.) and *M.* (*Aulacorthum*) *solani* (Kalt.), overwinter in eastern Scotland, primarily as apterae on perennial, glasshouse, frame and brassica crops. Brassica crops are the commonest food-plants of overwintering *Myzus persicae*, the principal vector of potato leaf-roll and Y viruses, and these crops are concentrated in the market-gardening areas of the Lothians and Moray. From surveys in 1953–56, it was concluded that, although crops of savoy cabbage and brussels sprouts often carried numerous *M. persicae* during the winter, spring cabbage, cabbage for seed and broccoli seem the most important overwintering food-plants because they usually persist until mid-May, long enough to allow the development and dispersal of alatae to spring-planted crops. Many alatae dispersed during July and August from crops colonised in spring. Although *M. persicae* overwintered as eggs on peach and viviparously on plants in glasshouses, the influence of such sites, which are generally distributed throughout the main seed-potato growing areas of Angus, Perth and Fife, was local and, unless numerous *M. persicae* survive the winter on weeds, the market-garden area of the Lothians is probably the most important source from which this aphid disperses in spring and early summer to colonise potato crops in eastern Scotland.

Surveys in 1954–56 showed that potato crops in most districts of eastern Scotland were infested by the aphids, *M. persicae*, *Macrosiphum solanifolii* and *M. solani*. Crops in different districts became infested by *Myzus persicae* at different times and to different extents, and these differences seemed consistent between years. Crops in the Edinburgh area were colonised between mid-May and mid-June, whereas crops in north Perthshire

escaped infestation until the end of July or mid-August. The time and degree of infestation by *M. persicae* seems correlated with distance from sites where this aphid overwinters. Trap records show that many alates of *M. persicae* disperse from outdoor brassica and early potato crops in the Edinburgh area between mid-July and mid-August, a period during which potato crops in Fife, Angus and Perthshire usually become infested. The freedom of crops in the better seed-producing areas from widespread infection by potato leaf-roll and Y viruses is probably associated with lateness of aphid infestation rather than scarcity of aphid vectors [*cf. R.A.E.*, A **46** 307].

Joyce (R. J. V.) & Roberts (P.). **The determination of the size of plot suitable for cotton spraying experiments in the Sudan Gezira.**—*Ann. appl. Biol.* **47** no. 2 pp. 287–305, 13 figs., 10 refs. London, 1959.

The following is almost entirely the authors' summary. An experiment on the influence of interplot effect (defined as the interaction of one plot with the insect population on an adjacent plot) in modifying the results of insecticide applications to cotton was carried out in the Sudan Gezira in 1955–56. The effect is considered to result in three possible ways, namely from spray drift [*cf. R.A.E.*, A **46** 368], from the movement of insect pests, and from the movement of insect parasites or predators. In the experiment, care was taken to minimise spray drift. The plots were fields of about 10 or 20 acres within larger areas of about 90 and 180 acres, respectively.

There was strong evidence that the yields of fields on the boundaries between sprayed and unsprayed fields were affected by the treatments on the other side of the boundary; sprayed fields yielded less when adjacent to unsprayed fields and unsprayed fields more when adjacent to sprayed ones. When ten-acre fields in areas of 90 acres were left unsprayed and were separated by 150 or 450 m. of unsprayed cotton from sprayed fields, infestation by *Empoasca lybica* (de Berg.), *Heliothis armigera* (Hb.), *Earias insulana* (Boisd.) and *Platyedra gossypiella* (Saund.) was not measurably changed, but the combined infestation by *Caliothrips* (*Hercothrips*) *fumipennis* (Bagn. & Cam.) and *C.* (*H.*) *sudanensis* (Bagn. & Cam.) was significantly reduced and infestation by *Bemisia tabaci* (Gennadius) was slightly increased, as compared with those found on ten-acre fields within 90 acres of completely unsprayed cotton, the changes in infestation corresponding to the distance from the sprayed cotton. Yields from such fields tended to be higher than those from within completely unsprayed cotton, although the differences were not significant. When 20-acre fields in areas of 180 acres were left unsprayed and were separated by 150 or 450 m. of unsprayed cotton from sprayed fields of similar size, there were no apparent differences when their insect infestations or yields were compared with those from 20-acre fields within 180 acres of completely unsprayed cotton.

These results are evidence that interplot effect might have affected infestations and yields in ten-acre fields of unsprayed cotton at distances of 150 or 450 m. from sprayed cotton. No such interplot effect was apparent when 20-acre fields were used. As spray drift was unlikely to have caused these results, they must have been due to the movement of insect pests, parasites or predators. It is concluded that in experiments in the Gezira in which treatments affect the whole of the insect complex on cotton, it is dangerous to assume that a ten-acre field in a 90-acre area is independent of differently treated fields in that area. On the other hand, independence can probably be assumed in 20-acre fields in 180-acre areas of cotton, provided that the field is separated from its differently treated neighbour by at least 150 m.

Joyce (R. J. V.). **The yield response of cotton in the Sudan Gezira to DDT spray.**—*Bull. ent. Res.* **50** pt. 3 pp. 567–594, 4 graphs, 6 refs. London, 1959.

The following is based on the author's summary. In the Sudan Gezira, some 250,000 acres of cotton of the Egyptian type are grown annually by gravity irrigation from the Sennar Dam, and the crop is sprayed with DDT, 6–10 weeks after sowing, to control *Empoasca lybica* (de Berg.), which is considered to reduce the yield [*R.A.E.*, A **40** 367]. The seasonal yield response to DDT was estimated by comparing the yields of single sprayed and unsprayed fields, each about 90 acres in area, pairs of which were selected in each of the 40 administrative blocks into which the cotton estate was divided. In order to show that the estimate adequately represented the response of the estate as a whole, it was necessary to demonstrate the validity of the assumptions that the sample was representative, that the unsprayed plots, though surrounded by sprayed cotton, were sufficiently large to behave in respect of yield as if their environment had not been sprayed, and that the selection of the fields was effectively random. Examination of the yield histories of the sprayed fields showed that there had been a slight bias towards the selection of fields that yielded better than the mean of the locality, and although this bias did not change from place to place or year to year, it did increase with level of yield. It was not, however, considered big enough to invalidate the first assumption. The second assumption was tested by an experiment [*cf.* preceding abstract], which provided no evidence to suggest that a 90-acre field would be affected in respect of yield and insect pests by proximity to a differently treated neighbouring field. The third assumption could not be proved, but during two seasons in which fields were selected by a random procedure, the results did not differ seriously from those in years in which the choice was not completely random. Moreover, when the yield of fields selected for treatment in one year were examined for the season when the fields were last cropped with cotton, and spray treatments were identical, they were found not to differ significantly, although the differences were increased and became significant in the year when sprayed and unsprayed treatments were applied. Accordingly, the yield of the unsprayed sample is taken to indicate what the yield of the whole estate would have been if all the cotton had been unsprayed.

The yield response to DDT, as thus estimated over the period from 1949–50 to 1956–57, was shown to vary from season to season. A highly significant part of this variance was correlated with the amount of rain falling in July, some six weeks before sowing, but the response was also significantly affected by both seasonal and site effects that were likewise correlated with this early rain. Experiments in 1956–57 showed that Domains Sakel cotton, which is grown in the drier, northern part of the Gezira, tended to give an increased response to DDT at higher levels of nitrogenous fertiliser, and that a very highly significant part of this response was due to the control of *E. lybica* and *Caliothrips* spp. The variety X1730A, grown in the wetter, southern part of the Gezira, gave no over-all response to spraying, nor was the response to nitrogenous fertiliser affected by it. When the yields of these varieties were examined separately over eight seasons, it was found that Domains Sakel gave a mean yield response to spraying of about 333 lb. seed cotton per acre, which did not vary significantly from season to season, but that X1730A gave a yield response that was less when pre-sowing rains were good and nitrogenous fertiliser was applied. Although the regression on July rains and on fertiliser of the response of X1730A to spray failed to reach significance at $P = 0{\cdot}05$, it is considered that further data should enable a

prediction of yield response of this variety to DDT to be made by examination of these two factors.

Since 1935–36, yields of cotton in the Gezira have been positively correlated with the amount of rain falling between 1st July and 15th August of the year of sowing. Comparison of the coefficient of regression of yield on this rainfall in the period from 1935–36 to 1947–48, before sprays or fertiliser were applied, with that of the period from 1935–36 to 1954–55, including six seasons in which sprays and fertiliser were applied, shows that the latter is only about half the former. After allowing for differences in varietal response to spraying and fertiliser, it can be shown that this decrease in the deleterious effect of a deficiency in pre-sowing rains is almost exactly accounted for by the beneficial effect of DDT spray.

It is concluded that at least half the deleterious effect of poor pre-sowing rains on yield is due to pests, which can be eliminated by DDT. The study thus provides a means whereby the spray can be applied selectively to those areas of the Gezira where its effect is likely to be most profitable, and suggests, moreover, that such a policy would reduce the considerable seasonal fluctuations in cotton yields that have characterised the area in the past.

Bennett (F. D.) & Hughes (I. W.). **Biological control of insect pests in Bermuda.**—*Bull. ent. Res.* **50** pt. 3 pp. 423–436, 19 refs. London, 1959.

The following is almost entirely the authors' summary. Projects undertaken for the biological control of insect pests in Bermuda since the first introduction of *Bufo marinus* in 1875 and including those still in progress are reviewed. Work on 15 pests or groups of pests has been undertaken, involving the introduction of over 100 species of beneficial organisms. *Icerya purchasi* Mask. is considered to be under excellent control on *Citrus*, as a result of the introduction of *Rodolia cardinalis* (Muls.) [*cf. R.A.E.*, A **39** 150] and a Dipterous parasite, *Cryptochetum iceryae* (Will.). *Pseudaulacaspis pentagona* (Targ.), a serious pest of oleander (*Nerium oleander*), was brought under control about 1922 by the introduction of *Aphytis diaspidis* (How.) [**13** 136]. However, heavy infestations have since developed periodically [*cf.* **46** 268]. In addition to *A. diaspidis*, two Aphelinids, *Aspidiotiphagus citrinus* (Craw) [*cf.* **37** 37, etc.] and *A. lounsburyi* (Berl. & Paoli) [*cf.* **37** 37], two Coccinellids, *Lindorus lophanthae* (Blaisd.) [*cf.* **39** 148] and *Chilocorus cacti* (L.) [*cf.* **46** 269], and a Nitidulid, *Cybocephalus* sp. [*cf.* **39** 149; **46** 269], now attack it.

Comstockiella sabalis (Comst.) at one time caused severe injury to the native palm, *Sabal bermudiana*, but was brought under control by the introduction of *Physcus* sp. [*cf.* **23** 112; **25** 786]. *Bracon gelechiae* Ashm. was introduced against *Gnorimoschema operculella* (Zell.) [*cf.* **39** 149, etc.], but satisfactory control of this pest of potatoes has not resulted.

Carulaspis minima (Targ.) [*cf.* **46** 416] and *Lepidosaphes newsteadi* (Šulc) have decimated the stands of Bermuda cedar (*Juniperus bermudiana*) despite an extensive programme of biological control [*cf.* **40** 301, etc.]. *C. minima*, which proved to be the more injurious, is attacked by the Aphelinids, *Prospaltella* sp., *Aspidiotiphagus lounsburyi*, and *Aphytis* sp., and the Coccinellids, *Lindorus lophanthae* and *Microweisea suturalis* (Schwarz), which were liberated in large numbers. The predacious mite, *Hemisarcoptes malus* (Shimer) [*cf.* **37** 37; **39** 149], and the fungus, *Myiophagus ucrainicus*, became established on *Lepidosaphes newsteadi*, which for unknown causes became very scarce after 1948. Damage by *Calpodes ethlius* (Cram.) to the leaves of ornamental *Canna* is less severe since the introduction of *Oencyrtus* sp. and *Trichogramma* sp., which parasitise the eggs.

Several parasites were liberated against mealybugs. *Pseudococcus adonidum* (L.), a pest of ornamental plants, is under satisfactory control as the result of the establishment of the Encyrtids, *Tetracnemus peregrinus* Comp. and *Anagyrus fusciventris* (Gir.). *Planococcus citri* (Risso) is now attacked on croton (*Codiaeum variegatum*) by the introduced Encyrtids, *Leptomastidea abnormis* (Gir.) and *Pauridia peregrina* Timb., as well as by *Leptomastix dactylopii* How., which was present at the start of the investigation. The introduced *Acerophagus pallidus* Timb. has been recovered from *Phenacoccus gossypii* Tns. & Ckll.

An Encyrtid, *Microterys kotinskyi* (Fullaway), and two Coccinellids, *Azya luteipes* Muls. and *Cryptolaemus montrouzieri* Muls., have been effectively introduced against *Pulvinaria psidii* Mask. on oleander. Tree lizards, *Anolis* spp., which feed readily on *Azya* and *Cryptolaemus*, are considered undesirable, and an introduced Passerine bird, *Pitangus sulphuratus*, has recently been liberated in an attempt to reduce their numbers [*cf.* **46** 416]; work in progress on the control of the lizards cannot yet be evaluated. Several introduced species of parasites and predators were liberated against *Saissetia oleae* (Bern.), *S. coffeae* (Wlk.) and *Coccus hesperidum* L. on various plants. *Aphycus stanleyi* (Comp.) is well established on *Saissetia* spp. Although the Braconid, *Opius humilis* Silv., was established on *Ceratitis capitata* (Wied.) for some years [*cf.* **23** 713; **24** 566], it has now disappeared. Parasites and predators introduced against *Nipaecoccus nipae* (Mask.), *Thrips tabaci* Lind. (on onion) and *Oligonychus ununguis* (Jacobi) (on *J. bermudiana*) did not become established.

Factors that may have contributed to the failure of establishment of some beneficial organisms are discussed.

Das (G. M.). **Observations on the association of ants with Coccids of tea.**—*Bull. ent. Res.* **50** pt. 3 pp. 437–448, 1 pl., 24 refs. London, 1959.

The following is virtually the author's summary of the observations reported, which were carried out with a view to the control of ants that nest on tea bushes and are a nuisance to workers.

Certain species of Coccids that excrete honeydew and are attended by ants or enclosed in their nests are prevalent on tea bushes and seed trees in the plains of Assam and West Bengal, but those that are not attended by ants are kept under considerable check by the activities of their natural enemies. In Darjeeling, where the natural enemies are fewer, several species occur abundantly and are often responsible for serious damage to tea. From studies of the relative populations of the ant, *Crematogaster dohrni* Mayr, and the Coccid, *Saissetia formicarii* (Green), occurring on tea bushes it is doubtful whether more than a small portion of the food requirement of the vast ant population in the nests that contain sexual forms could be met from the honeydew excreted by the small number of Coccids enclosed therein. The major part of the food must, therefore, come from other sources. Insects attacking or visiting the tea bushes and seed trees or even those found on the ground appear to constitute the major part of the food of *C. dohrni* and *Oecophylla smaragdina* (F.).

Several factors are responsible for the decrease in the population or disappearance of the Coccids in the absence of attendant ants. In the plains, *Eriochiton theae* Green, *Coccus hesperidum* L. and *S. formicarii* disappear in the absence of attendant ants owing to the activities of their natural enemies, contamination with honeydew or both. Parasitism may be slightly higher in ant-free colonies, but no estimation was possible since, in the absence of ants, the Coccids are quickly destroyed by predators. The ants do not protect the Coccids from Hymenopterous parasites, but their active

movements hinder the parasites in their efforts to oviposit, and this leads to a reduction in the rate of parasitisation. In the presence of *O. smaragdina* and *Crematogaster dohrni*, predators are rare; they are destroyed as are any other insects or any foreign bodies that happen to be near their nests, whether they constitute food or not. The larvae of predators that have a protective covering or that resemble Coccids, if they happen to have gained access to the Coccid colonies, are not attacked by the ants, because they are not recognised as different from the Coccids.

O. smaragdina does not normally transport Coccids, though young nymphs of *E. theae* and *Coccus hesperidum* may be aided in their dispersal, but *Crematogaster dohrni* and *Crematogaster* sp. are primarily responsible for the dispersal of *S. formicarii*, and this takes place when an occasion arises to remove the Coccid to more favourable sites. *O. smaragdina* does not destroy the nymphs and sedentary form of *Coccus hesperidum* for food, but sedentary forms that are unable to establish themselves on transfer from withered leaves to a new nest are eaten. With the control of the attendant ants, the honeydew-producing Coccids disappear or at least become rare. Conversely, where the Coccids are controlled, the ants automatically disappear.

Milne (A.). **Biology and ecology of the garden chafer, *Phyllopertha horticola* (L.). VI. The flight season: reproductive state of females.**—*Bull. ent. Res.* **50** pt. 3 pp. 467–486, 2 graphs, 7 refs. London, 1959.

The following is substantially the author's summary. This sixth part of a series on *Anomala* (*Phyllopertha*) *horticola* (L.) in the English Lake District [*cf. R.A.E.*, A **47** 165, etc.] deals with the reproductive state of the females during the flight season. Total egg-production depends entirely on stores (the fat-body) accumulated in the final larval instar [*cf.* **44** 184]. On the average, the fat-body enables about 16 or 17 eggs to be matured per female, the usual range being 9–32 [*cf.* **44** 185], and the rate of reproductive development is the same in the largest and smallest female adults. Mass aspects of the female reproductive state during the two phases of the flight season [*cf.* **47** 47] are described.

At primary emergence on the grass sward, the females contain some fat-body, together with some fully developed or immature eggs or both. An average of about one-third of the full complement of eggs is mature, the range being from none (with about 50 per cent. of the original fat-body still remaining) to four-fifths (with about 10 per cent. of the fat-body). Since primary emergences in a homogeneous population extend over about a fortnight, females taken from the grass sward throughout phase 1 are in various reproductive states. Thus, after the first few days of this phase and until the last individual makes its primary emergence, sample females may have half their fat-body and no eggs yet fully matured or no fat-body and all their eggs actually laid, or any intergrade between these extremes. Towards the end of phase 1 (which finishes about a week after the last primary emergence), females have no fat-body remaining and have already laid most or all of their eggs; a few of them now have food in the gut.

In phase 2, about 99 per cent. of the females on bracken, hedges and trees contain no fat-body and therefore cannot produce any more eggs. On the average, they have two mature or very nearly mature eggs left (range 0–26), and this egg content is much the same as at death. The remaining females are aberrant, with some fat-body still unconsumed. The females that shoot out bullet-like from the bracken, hedges or trees to alight comparatively far afield (referred to as ' bee-liners ' [*cf.* **47** 47]) either have some fat-body remaining or, if not, contain considerable numbers of eggs (a mean of about 9, compared with the general mean of 2). Thus, these females are the

phase-2 individuals with most eggs still unlaid and obviously constitute a minority.

Deductions as to individual behaviour are made from the mass aspects of the reproductive state and are to be examined in a subsequent part. Since females of *A. horticola* have already laid all or most of their eggs before appearing on hedges and trees, gardeners will not control this pest by killing all they find in these situations.

COAKER (T. H.). **Investigations on *Heliothis armigera* (Hb.) in Uganda.**—*Bull. ent. Res.* **50** pt. 3 pp. 487–506, 7 figs., 24 refs. London, 1959.

The following is substantially the author's summary. A survey of the populations of eggs and larvae of *Heliothis armigera* (Hb.) was made at Namulonge, in southern Uganda, in 1954–57 on cotton, maize, groundnuts, beans and, in one year, sunflower [*Helianthus annuus*]. The populations encountered were low in comparison with some other cotton areas in Africa. The oviposition rate on each crop closely followed the flowering cycle, and there was no indication that the population from one crop influenced that on a subsequent crop, even when their flowering cycles overlapped [*cf. R.A.E.*, A **28** 227]. Under the normal crop sequence, there is a sufficient gap between the attractive phases of successive crops to cause dispersal, possibly to wild food-plants, of the moths emerging from pupae that develop on the preceding crop. The variation in population from year to year on a given crop was no greater than that between different localities in any one season. Maize and sunflower did not prove effective when tested as trap crops grown adjacent to cotton [*cf.* **28** 228]. *Earias* spp. (*E. biplaga* Wlk., *E. insulana* (Boisd.) and *E. cuprcoviridis* (Wlk.)) and *Argyroploce leucotreta* Meyr. were less abundant than *Heliothis* and together constituted only 27 per cent. of the total population of Lepidopterous larvae on cotton.

A method is described for breeding *H. armigera* in the laboratory, where the mean durations of the egg, larval and pupal stages were 4, 24·8 and 22·9 days and the preoviposition and oviposition periods lasted 3·1 and 10·4 days, respectively. The mean number of eggs laid per female was 751·6, of which 71·4 per cent. hatched. Diets consisting of different species and parts of food-plants caused significant differences in the durations of the larval and pupal periods, the former being least (21·8 days) on maize silks and greatest (33·6 days) on sunflower corolla and receptacle, and the latter least (19·7 days) after larval feeding on maize cobs three weeks old and greatest (26 days) on cotton bolls seven weeks old. Pupae developing from larvae collected from the field did not undergo a diapause or resting stage.

Two egg parasites and 15 larval parasites (three of which were probably secondary) were bred from material of *H. armigera* collected in the field, but the degree of parasitism remained low throughout the year. A nuclear polyhedral virus disease of the larvae [**47** 406] was also recorded.

It is concluded that under the climatic conditions encountered, *H. armigera* is active throughout the year because wild or cultivated food-plants are always available and no resting stage of the insect is induced; this continuous activity is accompanied by factors of biological control that maintain populations stable at a relatively low level.

SYMMONS (P.). **The effect of climate and weather on the numbers of the red locust, *Nomadacris septemfasciata* (Serv.), in the Rukwa Valley outbreak area.**—*Bull. ent. Res.* **50** pt. 3 pp. 507–521, 3 graphs, 21 refs. London, 1959.

The following is virtually the author's summary. An examination of the records from 1930 onwards shows that a very high level of Lake Rukwa is

correlated with small numbers of *Nomadacris septemfasciata* (Serv.) in the Rukwa Valley outbreak area in Tanganyika. When the lake level is not very high, the size of the adult locust population (taken as that present in the middle of the dry season) is correlated negatively with the total rainfall of the last but one wet season (broadly, November–May), positively with the size of the preceding parental population (taken as that present at the time of oviposition) and possibly also with the rainfall of the preceding October–December, but not significantly with the date of the drop in temperature that is thought to be associated with the start of ovarian development [*cf. R.A.E.*, A **46** 411].

Three tentative explanations of the correlation between adult population and rainfall are offered. First, if the water-table is high because of heavy rain in the previous season, the early rains may make the soil unsuitable for successful egg-laying and incubation; second, after a season of heavy rainfall the grass cover may be particularly dense at the end of the following dry season and the consequent reduction of the oviposition sites may make breeding unsuccessful [*cf.* **47** 371]; third, parental mortality may be high during a dry season following heavy rains. These possibilities are being further investigated.

It is suggested that by using a multiple regression equation incorporating the correlations that have been established, the size of the adult locust population can be forecast in time for the scale of hopper control measures to be appropriately modified and economies thereby achieved.

Brown (E. S.). **Immature nutfall of coconuts in the Solomon Islands. II. Changes in ant populations, and their relation to vegetation.**—*Bull. ent. Res.* **50** pt. 3 pp. 523–558, 5 pls., 8 figs., 4 refs. London, 1959. **III. Notes on the life-history and biology of** *Amblypelta*.—*T.c.* pp. 559–566, 1 pl., 1 fig., 9 refs.

Miller (N. C. E.). **Results of the Archbold Expeditions. On the Reduviidae of New Guinea and adjacent islands (Hemiptera-Heteroptera). Parts 1–2.**—*Nova Guinea* (N.S.) **9** pt. 1 pp. 33–143; pt. 2 pp. 145–229, 680 figs. Leiden, 1958.

The first two of these papers form parts of a series [*cf. R.A.E.*, A **47** 168], and the following is based on the author's summary of the first of them. In the Solomon Islands, the incidence of immature nutfall of coconuts caused by Coreids of the genus *Amblypelta* (chiefly *A. cocophaga* China) depends indirectly upon certain species of ants, some of which protect the palms against *Amblypelta*, while others do not [*loc. cit.*]. There is evidence that the ant populations can sometimes change quite rapidly and that local fluctuations in nutfall are largely dependent on such changes [*cf.* **44** 466]. Observations on ant populations were made in 1954–56 to find whether such changes are common and to attempt to explain their cause. An account is given of views current in 1954 on the effect of vegetation [*cf.* **40** 208] and other factors [*cf.* **44** 466] on changes in ant populations, and in particular of the theory that the presence of cover-crops or creepers, which were prevalent in plantations during and after the war, provide conditions favourable to beneficial ants. The actual progress of recorded changes in ant populations is described and discussed. Rapidly changing ant populations usually involve *Pheidole megacephala* (F.), *Oecophylla smaragdina* (F.) and sometimes *Anoplolepis longipes* (Jerd.); more stable populations usually involve *Iridomyrmex myrmecodiae* Emery and occasionally *Oecophylla* and *Anoplolepis*.

The vegetation found in coconut plantations in the Solomon Islands is

described, with special reference to the plant communities associated with each of the four species of ant of special importance in immature nutfall, and also with mixed ant populations. It is concluded that heavy creeper growth is not particularly associated with *O. smaragdina* (as was thought by supporters of the creeper theory) or with the other beneficial species (*A. longipes*), but rather, if anything, with *P. megacephala*, a non-protective or harmful species; there is thus no good reason to suppose that a growth of creepers will encourage beneficial species. *I. myrmecodiae* is the only species of the four that tends to be associated with a characteristic type of vegetation, including several species of epiphytes and often heavy creeper growth, but there is evidence that epiphytic vegetation may to some extent be the result rather than the cause of the presence of *Iridomyrmex*. It is concluded that vegetation is not an important factor controlling ant distribution, except in so far as heavy growth of creepers and other plants may encourage a more mixed ant population in general, including several indigenous species that are not normally conspicuous in well-maintained plantations; if there is any effect on the four major species, it is to encourage *Pheidole* and *Iridomyrmex* at the expense of *Oecophylla* and *Anoplolepis*.

Two experiments were carried out that involved control of creepers and other vegetation by repeated cutting down or ' brushing ' in marginal zones between areas occupied in one case by *I. myrmecodiae* and *A. longipes* and in the other by *O. smaragdina* and *P. megacephala*, to see whether this practice would alter the course of changes in population already taking place. In neither was there any appreciable difference in the course of events between ' brushed ' plots and adjacent ones with uncontrolled vegetation, which supports the conclusion that the presence or absence of creepers and other vegetation has little, if any, effect on changes in ant populations. In one of the areas (Rua Vatu), where an extensive replacement of *P. megacephala* by *O. smaragdina* was taking place, accompanied by recovery from a condition of heavy nutfall, detailed studies showed that this replacement was not a direct one, but that, at all events for the most part, a succession of normally unimportant transition species first replaced *Pheidole* and were in turn replaced by *Oecophylla*. The details of this succession are described and discussed. Evidence is produced to suggest that a similar succession may have been involved in recorded examples of recovery from nutfall in other places, notably in that which occurred in a group of plantations on Guadalcanal after the war [*cf.* **44** 466]. These conclusions present a picture not so much of direct antagonism between *Pheidole* and *Oecophylla*, as of the initial disappearance of *Pheidole* owing to unknown intrinsic factors, followed later by the infiltration of *Oecophylla* in the wake of a variable succession of indigenous transition species, which increase in numbers temporarily during the interim period when the area is not dominated by either of the two major species. In view of this, it is not unlikely that a factor such as vegetation should have little or no direct effect on the change. As regards the replacement of *Oecophylla* by *Pheidole*, the little evidence available suggests that it is more direct. The fact that recovery from nutfall took place recently at Rua Vatu, at a time and place at which insecticides had not been applied, contradicts the view that the earlier and similar recovery in the groups of plantations on Guadalcanal was the result of a differential effect on ant species of the application of insecticides for mosquito control during the war [*cf.* **44** 466].

The following is largely based on the summary of the second paper. Observations on the population density of *Amblypelta cocophaga* on coconut palms in the Solomon Islands in June–July 1956 are described. Although the densities were somewhat higher than those reported for the related coconut Coreid, *Pseudotheraptus wayi* Brown, in Zanzibar [*cf.* **46** 413], they

were still very low (less than one per palm). The principal oviposition sites, contrary to previous findings, were on the undersides of the fronds, in the basal recesses of the leaflets. The newly hatched nymphs have to make their way to the spadices in the centre of the palm crown; this explains why first-instar nymphs are rarely found on the spadices and also why a single application of insecticide is not completely effective, the oviposition sites escaping treatment. Totals of 20 and 26 eggs were found on two palms examined, and 90 and 73 per cent. of these, respectively, were on the fronds and the rest on the spadices. Numbers of eggs were about equal on old and young fronds and tended to be greatest on fronds of medium age. *Anastatus axiagasti* Ferrière was common and parasitised 55 and 15·5 per cent. of the eggs on these trees, with an average of 33·3 per cent. The percentage of eggs that hatched ranged from 38 to 19 per cent., with an average of 31·3 per cent. Investigation of the area in Malaita in which a Tachinid parasite, *Trichopoda pennipes* (F.), had been released against *Amblypelta* in 1949 [**40** 209] indicated that it has not survived there, or, if it has, is exercising no control over the Coreid. Two predators that may affect nutfall were observed. They are a Reduviid described in the second part of the third paper as *Pristhesancus browni*, sp. n., which was not uncommon in the crowns of the palms in nutfall areas and, though not known to feed on *Amblypelta* in the field, did so readily in cages, and a chelifer, *Paratemnus salomonis* Beier, which lives in crevices in the trunks of palms occupied by *O. smaragdina* or, sometimes, *Anoplolepis longipes*, and preys on the ants. *O. smaragdina* has been found by F. L. Vanderplank to be similarly attacked by *P. ellingseni* Beier in Zanzibar.

West African Cotton Research Conference held at the Regional Research Station, Ministry of Agriculture, Samaru, Northern Nigeria 18th to 23rd November, 1957.—v + 209 pp. Samaru, Minist. Agric. [? 1959].

The papers on insect pests of cotton and their control read at this conference comprise the following:—

Angelini (M.). **Quelques résultats obtenus en Côte d'Ivoire dans la recherche des moyens permettant de limiter l'incidence du parasitisme sur la production cotonnière,** pp. 107–112. (With a summary in English.) Notes are given on numerous insects that attack cotton in the central Ivory Coast, on the insecticides that have proved effective for their control, on methods in use for determining population levels, and on work in progress on resistance of cotton to *Platyedra gossypiella* (Saund.), which is the most important of the pests towards the end of the season.

Coaker (T. H.). **Crop loss by insect pests in Uganda,** pp. 113–115. (With a summary in French.) The two main pests of cotton common over the whole of Uganda are *Lygus vosseleri* Popp. and *Heliothis armigera* (Hb.). Experiments in which insecticides were used to control them indicated that early-season damage by *Lygus* is largely overcome as the plants develop and that late-season attack by *Heliothis* is the main cause of yield reduction. Control did not always increase the yield, however, and insecticides should be used only when it is estimated that insect damage will be more than the plant can withstand without yield loss [*cf. R.A.E.*, A **46** 43].

Dineur (P.). **La désinsectisation des cotonniers au Congo Belge,** pp. 116–117. (With a summary in English.) Insecticides were first used on cotton in the Belgian Congo in 1952, and notes are given on those found effective and the apparatus used for applying them. Control of *Lygus vosseleri* Popp. has proved advantageous in the south.

Choyce (M. A.). **Insecticide trials on cotton in Northern Nigeria,** pp. 118–130, 5 graphs, 4 refs. (With a summary in French.) The following is

based largely on the author's summary. Tests with insecticides, chiefly sprays of DDT alone or with BHC, on cotton at Samaru and Daudawa, Northern Nigeria, designed mainly with the object of controlling *Diparopsis watersi* (Roths.), gave variable results, and yield increases of more than 200 lb. seed cotton per acre were rarely obtained. The reason suggested for this is that insect pests are not normally the most important factor in restricting the yield to low levels. The widespread use of insecticides is therefore not recommended for this area, except possibly for special purposes. If the yield potential of the crop could be increased, the use of insecticides might become desirable. In similar tests at Mokwa (in Niger Province), where *Dysdercus superstitiosus* (F.), the dominant pest, enters the crop in September–October and produces two further generations before harvest, sprays of DDT and BHC resulted in substantial yield increases, so that insecticides might profitably be used there.

Schmitz (G.). **L'*Helopeltis* du cotonnier (*H. schoutedeni* Reuter),** pp. 131–136. (With a summary in English.) The information here given on the bionomics and control of *Helopeltis schoutedeni* Reut. on cotton in the Belgian Congo has already been noticed from a fuller account [**47** 395].

Dineur (P.). **La psyllose,** pp. 137–138, 1 ref. (With a summary in English.) Injury has been caused since 1940 to cotton in the Belgian Congo by *Paurocephala gossypii* Russell [*cf.* **31** 471]. The older leaves and stalks of infested plants acquire a purple tint, and rosettes of stunted, scale-like leaves are formed. The attack leads to complete sterility of the plant, and no recovery is possible. Only the nymphs of the Psyllid are responsible, and the cause of the condition, whether a virus or a toxic secretion of the insect, is not known. A period of 2–8 weeks elapses between infestation and the first appearance of symptoms, and the course of the latter depends on the age of the plant, the number of insects present and the degree of exposure to sunlight. Cotton sown out of season or very early is the most severely attacked, and the damage is usually negligible on that sown at the usual time. The Psyllid is susceptible to insecticides, and the selection of resistant varieties of cotton offers some promise. *P. gossypii* has not been observed on any other plant.

Dineur (P.). **Essai de lutte contre le " Shimbu ",** pp. 139–140. (With a summary in English.) " Shimbu " is a disease caused by the association of an ant (*Camponotus* sp.), root-infesting Coccids, referred to as *Gueriniella* sp. [but found to comprise several species, of which one has been described as *Vrydagha lepesmei* Vayss. (**47** 9)], and a fungus (*Macrophomina phaseoli*) It occurs in the Gandajika region of the Belgian Congo, where it affects all the principal crops, including cotton; young plants are completely destroyed by it. It is supposed that the ants transport the Coccids to the young plants, on which the Coccids attack the subterranean parts, particularly the root collar, and that the fungus gains access either through the feeding wounds or by being transported on the rostra of the Coccids; the fungus cannot penetrate into the plant unaided, but the Coccids seem able to kill a plant without the intervention of the fungus. Good control was given by soil fumigation with D-D mixture (1,2-dichloropropane and 1,3-dichloropropene), which increased the yield of cotton and beans by 20 per cent., but was expensive, slow in action and unsuitable for use by peasant cultivators. Dieldrin gave good control of the ants and eliminated the disease when distributed by hand at 72–90 lb. per acre, and its effect persisted for the next 2–3 crops in the rotation. Soil cultivation is of some value.

Dineur (P.). *Lygus vosseleri* **Pop. (Capsidae),** pp. 141–143. (In French, with a summary in English.) *Lygus vosseleri* Popp. is the most important pest of cotton in the part of the Belgian Congo south of the equator. It destroys the vegetative buds and young leaves and causes shedding of

squares and young bolls. Its development is completed in about 39 days, and three generations can therefore develop during the cotton season. Infestation is favoured by a damp atmosphere, and the damage is most severe in forest regions. Many insecticides give good control, the required minimum dose being lowest for endrin, among the chlorinated hydrocarbons, and parathion, among the phosphorus compounds, but legislation forbids the use of these in peasant areas.

Coaton (W. G. H.). **The Hodotermitid harvester termites of South Africa.** —*Sci. Bull. Dep. Agric. S. Afr.* no. 375, iv + 112 pp., frontis., 51 figs., 20 refs. Pretoria, 1958.

In this bulletin on *Hodotermes mossambicus* (Hagen) and *Microhodotermes viator* (Latr.), the two harvester termites present in South Africa [*cf. R.A.E.*, A **41** 417], the subject matter of an earlier one [**38** 135] is rearranged and revised to incorporate more recent data, some of which have already been noticed [**43** 364]. It includes descriptions of castes of both species and information on their synonymy, distribution in South Africa, life-cycle, nesting and feeding habits, economic importance as pests of crops and in gardens and as agents causing denudation and erosion of the veldt, and control by means of sodium-fluosilicate baits, with a description of a method of bait processing developed for widespread campaigns on grazing land, as well as accounts of a large-scale campaign in progress in Zululand and an experiment on a farm in the Orange Free State demonstrating the value of termite control in promoting veldt recovery. Tests in fenced grazing areas in Zululand in 1950 showed that the restriction of grazing to two months in late summer, which, in the absence of infestation, enabled an even grass sward to develop rapidly, in infested areas neither permitted the re-establishment of a grass cover on denuded areas nor arrested erosion unless the termites were also controlled, and similar results were obtained in 1951 on unfenced, heavily infested, eroded veldt subjected to uncontrolled grazing. Reinfestation following control is initially low, provided that all foci round the treated area are eliminated, but the conditions produced by overgrazing favour the establishment of colonies, and a system of rotational grazing, or, where this is impossible, of permanent scouting and prompt elimination of reinfestation, is necessary for permanent control. Over 120,000 acres of heavily infested and completely denuded veldt had been successfully treated in this manner up to 1954. A discussion of the cost of treatment shows it to be economically justifiable. In the Orange Free State, a system of veldt management allowing no grazing during the growing season was adopted over many years on a farm heavily infested by *H. mossambicus*, but failed to prevent the encroachment of Karroo scrub vegetation on the original grass veldt. Control of the termites by baiting reversed the process within a year or two, even where suppression of the grass by scrub had been complete.

Cram (W. T.). **Gross anatomy and growth of the reproductive system of the black vine weevil,** *Brachyrhinus sulcatus* **(F.) (Coleoptera: Curculionidae).**—*Canad. Ent.* **90** no. 10 pp. 569–579, 7 figs., 14 refs. Ottawa, 1958.

The parthenogenetic weevil, *Otiorhynchus* (*Brachyrhinus*) *sulcatus* (F.) [*cf. R.A.E.*, A **24** 385], has increased rapidly on strawberry in British Columbia and the Pacific Northwest of the United States during the past few years and is now at least as important there as *O.* (*B.*) *ovatus* (L.).

Since the chief damage is from larval feeding on the roots, control measures should be directed against the females before they oviposit, especially where no soil insecticides have been applied [*cf.* **47** 229]. Investigations in British Columbia showed that oviposition does not become general until most or all of the crop has been harvested, and an insecticide could therefore be applied at this time, and also in late March or April against overwintered females, if the dates of oviposition could be predicted. The preoviposition period ranged from 27 to 43 days among 35 females kept in the laboratory at 68° F. and 75–85 per cent. relative humidity and from 46 to 63 days among 12 females reared singly in vials in the field. The development of the reproductive organs was studied in females reared in the laboratory from prepupae collected in Oregon, and descriptions are given of the mature organs and of their condition at the time of emergence and 15, 25 and 28 days later. Comparisons of the state of development in females from ten samples collected in Oregon between 7th June and 31st August 1954 with that of the laboratory-reared ones showed that it is possible to predict the date on which oviposition becomes general and also that two populations of different ages were present after 30th June. Oviposition by the earlier population became general about 7th July, and that by the later, more numerous one on 24th July.

MacKay (M. R.) & Rockburne (E. W.). **Notes on life-history and larval description of** *Apamea apamiformis* **(Guenée), a pest of wild rice (Lepidoptera: Noctuidae).**—*Canad. Ent.* **90** no. 10 pp. 579–582, 12 figs., 1 ref. Ottawa, 1958.

A Noctuid of which the larvae cause serious damage to the seeds of wild rice (*Zizania aquatica*) in Ontario was identified in 1958 as *Apamea apamiformis* (Gn.), and an account of its bionomics is given, with descriptions of the eggs and larvae. Eggs are laid in rows inside and at the base of the floret in July, and several hundreds may be deposited in a single inflorescence. The larvae feed at first in the inflorescences and later within the leaf sheaths and in the stalks, though there are rarely more than one or two per stalk. The winter is passed in the late larval stage, but not in the last instar. When late-instar larvae were provided with soil, they entered it in September, but they overwintered in the stalks if it was not then available and entered the soil in spring. Larvae were found in stalks floating on the water, and probably only those that reach the shore by this means or by crawling from adjacent plants complete their development. The few reared larvae that survived the winter subsequently fed on crushed peas and beans and reached the last instar. Only one gave rise to an adult, which emerged from the soil about a month after the larva had been brought from cold storage.

Finlayson (L. R.) & Finlayson (T.). **Notes on parasitism of a spruce sawfly,** *Diprion polytomum* **(Htg.) (Hymenoptera: Diprionidae), in Czechoslovakia and Scandinavia.**—*Canad. Ent.* **90** no. 10 pp. 584–589, 8 refs. Ottawa, 1958.

Some 505,000 cocoons of *Gilpinia (Diprion) polytoma* (Htg.) were shipped from Czechoslovakia, Finland, Sweden and Norway to Ontario in 1935–39 to obtain parasites for liberation against *G. (D.) hercyniae* (Htg.) on spruce [*cf. R.A.E.*, A **25** 12; **26** 103; **48** 17]. The latter was not then considered distinct from *G. polytoma* [**30** 341] and was also represented in the material collected, though in very small numbers. Information on the more important

parasites reared from *G. polytoma* is given in this paper. This sawfly produces one generation a year in Scandinavia and in one of the areas in which it was collected in Czechoslovakia and two generations elsewhere in Czechoslovakia. The field-collected larvae were usually allowed to form cocoons before shipment, and these were kept singly in small vials plugged with cotton-wool at about 24°C. [75·2°F.] and 60 per cent. relative humidity. Emergence of both hosts and parasites from first-generation cocoons began in the year in which they were collected and from the second-generation cocoons after storage for the winter at about 1°C. [33·8°F.]; some sawflies and parasites emerged after two winters in cold storage, and a few sawflies after three. There was no emergence from 42·7 per cent. of the cocoons. The Hymenopterous parasites reared included 27 species and a further 27 identified only to genus, and six Tachinid parasites and a beetle that may have been a scavenger were also obtained. Of the species from Czechoslovakia, 45 were reared from first- and 37 from second-generation cocoons, and 12 from the one-generation area; 16 species, seven of which were not represented in Czechoslovakia, were reared from the northern countries. The percentages parasitised by some of the more important species are shown in a table, and the patterns of emergence of the parasites in the laboratory are discussed. In general, the parasitism percentages were about twice as high in first-generation cocoons (21·3–26·1) as in second-generation ones (6·9–11·8) in Czechoslovakia, except in 1935, when they were lower (9·4); they reached about 17 in the single-generation area in Czechoslovakia and in the northern countries in 1936 and 24·6 in the latter in 1938. Numerous parasites emerged from first-generation cocoons after a winter in cold storage, but not from second-generation ones after two. All the parasites except six were solitary and, among the solitary species, males preponderated in all except *Exenterus* spp. and *Sturmia* (*Drino*) *inconspicua* (Mg.), in which the percentages of females were 57 and 53, respectively. The most abundant species were *Holocremnus ratzeburgi* (Tschek), *Lamachus marginatus* (Brischke), *Exenterus* spp., *Mesopolobus* (*Amblymerus*) *subfumatus* (Ratz.), *Monodontomerus dentipes* (Boh.) and *S. inconspicua* in Czechoslovakia and *S.* (*D.*) *bohemica* (Mesnil), *Blondelia* (*Ceromasia*) *inclusa* (Htg.), *L. marginatus* and *Lamachus* sp. in the northern countries. *H. ratzeburgi* and *L. marginatus* were the most important European species, but neither became established in Canada, although considerable numbers of both were released at times when the host was in a suitable stage. Of the species liberated in Canada [*cf.* **43** 171], 50 per cent. of those confined to northern Europe, 43 per cent. of those confined to central Europe and 29 per cent. of those present in both areas became established.

Arthur (A. P.). **Development, behaviour, and descriptions of immature stages of** *Spilochalcis side* **(Walk.) (Hymenoptera: Chalcididae).**—*Canad. Ent.* **90** no. 10 pp. 590–595, 10 figs., 5 refs. Ottawa, 1958.

An account is given of observations on the life-cycle of *Spilochalcis side* (Wlk.), made in the course of work in Ontario on parasites of species of *Recurvaria* that attack lodgepole pine (*Pinus contorta* var. *latifolia*), together with descriptions of the immature stages. The host material from which the stock was obtained was collected in Idaho and California, and the parasites were subsequently reared in the laboratory in pupae of *Depressaria heracliana* (L.), *Anagasta kühniella* (Zell.), *Galleria mellonella* (L.) and *Pyrausta nubilalis* (Hb.), cocoons of *Apanteles atalantae* (Pack.), *A. congregatus* (Say) and *A. glomeratus* (L.), and an unidentified Coleopterous case-bearer at a temperature of about 22·5°C. [72·5°F.] and 60–75 per cent. relative humidity. The larger host pupae were glued in the grooves of

corrugated cardboard with the ventral surface uppermost for exposure to the ovipositing parasites, so as to avoid injury to the latter. The adult males and females survived for up to five months. The females usually mated soon after emergence and oviposited after 6–8 days. The eggs hatched in 40–48 hours. Up to four were laid in a single host pupa, but only one larva usually survived beyond the first instar in small hosts; in larger hosts, two sometimes developed beyond this stage, and in one instance two adults emerged from one host. The parasite larvae fed for 6–10 days and pupated within the host. The average duration of complete development varied from 20 days in the smallest hosts (*Apanteles* spp.) to 25 in the largest (*G. mellonella*).

GRAHAM (A. R.). **Recoveries of introduced species of parasites of the winter moth, *Operophtera brumata* (L.) (Lepidoptera: Geometridae), in Nova Scotia.**—*Canad. Ent.* **90** no. 10 pp. 595–596. Ottawa, 1958.

Parasites introduced from Europe [*cf. R.A.E.*, A **44** 271] were released in 1954–56 against *Operophtera brumata* (L.) in Nova Scotia, where this Geometrid has been present since before 1950 [*cf.* **44** 226]. The five species with, in brackets, the total number of each released were *Monochaeta* (*Cyzenis*) *albicans* (Fall.) (2,044), *Agrypon flaveolatum* (Grav.) (436), *Lypha dubia* (Fall.) (27), *Phobocampe crassiuscula* (Grav.) (204) and *Pimpla turionellae* (L.) (188), but the last three were not recovered. Attempts to recover *M. albicans* in May 1955 from releases in the previous year were unsuccessful, but 32 puparia of the Tachinid were obtained from 2,100 larvae of *O. brumata* collected in June and July after a release on 3rd June. The ability of this parasite to overwinter was demonstrated in an experiment in which five adults and some additional host larvae were released in June 1955 in a wire-screen cage enclosing a small infested oak tree. After insect activity had ceased in July, the upper part of the cage was removed, the tree cut down, and the lower part covered with wire screen. In the following spring, vials were inserted in holes bored in the sides of the cage, which was then covered with plywood, and 11 adults of *M. albicans* were eventually trapped in them; on 28th May, four living pupae and 22 empty puparia of the Tachinid were found in the sand provided as pupating medium. In 1956, 24 pupae of *M. albicans* representing an overwintered generation were obtained from 1,700 field-collected larvae of *O. brumata*, and in November 1957, 49 parasite pupae were found to have developed in 10,069 host larvae collected in June. On dissection of the host pupae remaining after the emergence of the moths in December, 232 pupae of *A. flaveolatum* were also obtained. The combined parasitism by these two species amounted to 2·8 per cent. in 1957. In addition, there was 4·8 per cent. parasitism by native Diptera and 0·3 per cent. by nematodes. The investigations showed that larvae of *O. brumata* become full-fed about 20th June, regardless of their date of hatching. The best release dates for *M. albicans* and *A. flaveolatum* appear to be 5th and 10th June, respectively, when the larvae are in the third and fourth instars; these and later stages seem to be the most favourable for the parasites. *M. albicans* and *A. flaveolatum* were released in four additional localities in 1957.

EDWARDS (D. K.). **Two quantitative methods for measuring insect activity.** —*Canad. Ent.* **90** no. 10 pp. 612–616, 2 figs., 4 refs. Ottawa, 1958.

The following is virtually the author's summary. Two quantitative methods for obtaining indices of insect activity are described. One method

involves the photometric measurement of marks made by an insect moving on a soot-blackened layer of glass. In the second method, insect movements are converted into changing electrical currents; the latter are automatically summed. With both methods it should be possible, with a minimum of modification, to obtain activity data for insects in a variety of environmental conditions without appreciably affecting the efficiency of the recording apparatus.

Harcourt (D. G.) & Cass (L. M.). **A controlled-interval light trap for Microlepidoptera.**—*Canad. Ent.* **90** no. 10 pp. 617–622, 4 figs., 14 refs. Ottawa, 1958.

The following is the authors' summary. The design, operation, and performance of a light trap for capturing Microlepidoptera at predetermined intervals are described. The moths are drawn by a fan into a collecting cartridge, where they are apportioned by means of sweep discs. The discs contain crystals of potassium cyanide and fit snugly together, forming an asphyxiation chamber between adjoining discs. The discs are released by a tripping mechanism activated by a solenoid. The trap was operated successfully for five years. A typical night's capture is illustrated.

Harris (P.). **Life-history and natural control in British Columbia of *Ocnerostoma piniariella* Zell. (Lepidoptera: Yponomeutidae), a needle miner on white pine.**—*Canad. Ent.* **90** no. 10 pp. 627–631, 1 fig., 7 refs. Ottawa, 1958.

Ocnerostoma piniariella Zell., the immature stages of which are described, is an unimportant pest of Scots pine (*Pinus sylvestris*) in Europe. It was recorded in British Columbia in 1922, on white pine (*Pinus strobus*) [*R.A.E.*, A **11** 82], and has since been found at four other places there as well as at four in Ontario. In Ontario, it attacks *P. strobus*, but in British Columbia it is rare on this species and most abundant on *P. monticola* and a hybrid of *P. strobus* with *P. griffithii*. The Hyponomeutid also occurs in New York [**13** 177]. In British Columbia, the eggs are laid singly on the tips of the needles in late July and August, shortly after the emergence of the adults, and hatch in three weeks, mainly in September; 16 per cent. of the needles in the upper third of the tree, 11 per cent. of those in the middle, and 7 per cent. of those at the bottom were infested in 1954–55, but aspect and age of the needle had no significant influence on egg distribution. Each larva mines a single needle, in which it overwinters in the second instar and in which it again feeds in the following spring until May. When it reaches the last (fifth) instar, it leaves the mine and migrates to a needle cluster, which it binds together into a protective sheath. No feeding is done in this instar; pupation occurs two weeks later, inside the needle sheath. The first adults were found on 16th July in 1954. Two parasites, *Achrysocharis* sp. and *Alegina* sp., attacked the larvae, but the heaviest mortality (about 47–67 per cent.) was from unknown causes while the larvae were migrating to their pupation sites. High mortality also occurred among the overwintering larvae, which dried and shrivelled in the needles (about 15–32 per cent.), and as a result of the blockage of the exit from the pupal tube by another pupa or by wax and progeny produced by an aphid (17–25 per cent.), which prevent the adults from emerging. The needles damaged by feeding fell shortly after the larvae left them.

Peterson (L. O. T.). **The boxelder twig borer,** *Proteoteras willingana* **(Kearfott), (Lepidoptera: Olethreutidae).**—*Canad. Ent.* **90** no. 11 pp. 639–646, 12 figs., 14 refs. Ottawa, 1958.

Proteoteras willingana (Kearfott), all stages and the distribution of which are described, is of importance in the Prairie Provinces of Canada, where boxelder (*Acer negundo*), its only food-plant, is extensively grown in shelter belts and for shade. As a result of infestation, the dormant leaf buds are destroyed in autumn and early spring and spindle-shaped galls form on the young growth in May and June; the galls become woody, usually preventing further terminal growth and sometimes inducing an undesirable bushy habit. The first recorded severe and widespread damage in the Prairie Provinces occurred in 1915 [*cf. R.A.E.*, A **4** 249] and the subsequent incidence of *P. willingana* is briefly summarised from the literature. In recent years, peaks occurred in 1938, 1947–48 and 1955–56. In 1956, the percentages of twigs infested at sampling points in southern Manitoba and southern and central Saskatchewan were 13·4, 24·3 and 9·7, respectively.

Field and laboratory studies of the bionomics of *P. willingana* were made in Saskatchewan in 1936–38. Eggs are usually deposited singly on the lower surfaces of the leaves, commonly adjacent to the midrib or large veins. They hatched in 9–14 days and the first and last dates on which they were observed were 29th June and 2nd August. The larvae feed soon after hatching, usually in the angle between a vein and the midrib, or along the veins, beneath a silken shelter in which frass is incorporated. They destroy the mesophyll and the epidermis of one side of the leaf, the lower surface being preferred. Later, feeding extends beyond the shelter, to which, however, the larva returns to rest and moult. The second-instar larva may move to another feeding area on the same or a different leaf. The first and second instars lasted 4–9 and 6–9 days, respectively, in the insectary. Feeding on the leaves extends into the third instar, but 1–5 days after reaching this stage, the larva leaves the leaf and enters a dormant leaf bud, first making a web shelter with an opening at the lower edge plugged with frass. In 1936, 21 per cent. of the larvae had left the leaves by 26th July and 65 per cent. by 8th August. The larvae overwinter, usually in the fourth instar, but occasionally in the third or fifth, in silken cocoons in chambers hollowed out in the buds and sometimes extending into the twig. The fourth instar may be attained 22 days after the larva enters the bud, but is usually not reached until the end of September or later. Overwintering fourth-instar larvae are usually smaller than third-instar individuals.

Between late April and late May, most larvae enter another undamaged bud on the same stem, in which they feed and moult, and then burrow into the young tip growth, where they feed more extensively and sometimes construct chambers up to 1 in. in length. In late May or June, they fall to the ground and pupate in cocoons in the leaf mould. Some larvae do not leave the bud in which they overwinter, except to feed, until they are ready to pupate, and others enter two buds before burrowing into the tip growth. Pupation began about 29th May and was complete by the third week in July; the pupal stage lasted an average of 16 days in the open and 12 days in the insectary. The earliest and latest dates on which adult emergence was observed were 27th June and 19th July. Females comprised 56 per cent. of the adults that emerged in field cages and 10 per cent. of those taken at light between 13th and 23rd July. Oviposition occurred two days after emergence, and females dissected before oviposition contained an average of 108 well developed eggs. The maximum survival period in field cages was 15 days for males and 20 for females; of over 300 moths reared, few survived after 22nd July and none after 29th. Mortality of up to 9 per cent.

was recorded among overwintering larvae, but mortality among larvae in the buds and twigs in spring was negligible. Predators appeared to be unimportant as control agents, but some ten Hymenopterous parasites were reared. In 1936, an estimated 30 per cent. of the larvae in the buds and twigs were parasitised.

Jacobson (L. A.) & Blakeley (P. E.). **Development, mortality from starvation, and oviposition of the pale western cutworm,** *Agrotis orthogonia* **Morr. (Lepidoptera: Noctuidae), when fed on various food plants.**—*Canad. Ent.* **90** no. 11 pp. 650–653, 1 graph, 9 refs. Ottawa, 1958.

The effect of four foods on the growth and mortality of larvae of *Agrotis orthogonia* Morr. and the fecundity of the moths to which they give rise [*cf. R.A.E.*, A **23** 465] was investigated in the laboratory in Alberta, the larvae being reared by a method already noticed [**46** 316]. For larvae fed throughout their development, the larval periods were shorter, the pupae were heavier and the adults that emerged laid more eggs when the food was wheat (of the varieties Marquis or Thatcher) than when it was barley (Compana) or oats (Exeter). When the larvae were fed up to the fourth instar and then starved, all died in 16–20 days [*cf.* **41** 426], but the mean periods of survival were greater for larvae previously fed on the wheats than for those fed on the other cereals. It is pointed out in a discussion that the cultivation of unsuitable food-plants throughout an area may reduce populations by lowering fecundity, and that the practice commonly adopted of replacing wheat destroyed by *A. orthogonia* by oats or barley (which mature faster than wheat) provides for a further reduction in population, since mortality from starvation during the period before the appearance of the replacement crop may be supplemented by a reduction in fecundity.

Perron (J. P.), Jasmin (J. J.) & Lafrance (J.). **Varietal resistance of seeded onions to the onion maggot,** *Hylemya antiqua* **(Meig.) (Diptera: Anthomyiidae).**—*Canad. Ent.* **90** no. 11 pp. 653–656, 4 refs. Ottawa, 1958.

The following is based on the authors' summary. Field and greenhouse tests on 44 varieties of *Allium* spp. sown in muck soils in Quebec during 1955–57 showed that two varieties of *A. fistulosum* were significantly more resistant to attack by *Hylemyia antiqua* (Mg.) than a named hybrid of *A. fistulosum* with *A. cepa* (onion) or than four varieties of *A. cepa*, including one used as the standard of susceptibility.

Clark (R. C.) & Brown (N. R.). **Studies of predators of the balsam woolly aphid,** *Adelges piceae* **(Ratz.) (Homoptera: Adelgidae). V.** *Laricobius erichsonii* **Rosen. (Coleoptera: Derodontidae), an introduced predator in eastern Canada.**—*Canad. Ent.* **90** no. 11 pp. 657–672, 9 figs., 3 maps, 10 refs. Ottawa, 1958.

This fifth part of a series on the predators of *Chermes* (*Adelges*) *piceae* Ratz. on balsam fir (*Abies balsamea*) in eastern Canada [*cf. R.A.E.*, A **47** 120] contains accounts of the liberation and spread of the introduced Derodontid, *Laricobius erichsonii* Rosenh. and of studies on its bionomics [*cf.* also **42** 280] and value in control [*cf.* **46** 266]. Adults were liberated in 14 areas in New Brunswick in 1951–54, two in Nova Scotia in 1954–55, and

eight in Newfoundland in 1952–55. The predator became established at seven of nine release areas near Fredericton, New Brunswick, that were kept under close observation, and was recovered over a period of six years at one. The relative abundance of adults and larvae varied from year to year and area to area and depended largely on the prevalence of infested trees. Although establishment was possible on trees with prey populations as low as two per sq. in., the larvae were rarely found on trees with fewer than ten developing aphids per sq. in. Spread from the release points was slow and reached a maximum of 75 yards in the year of release; over a period, the recorded maximum was four miles in four years, but the actual maximum was probably greater. The results in the remaining areas in New Brunswick could not yet be assessed, and no information was available on establishment or spread in the other two Provinces.

Observations on the bionomics of *L. erichsonii* in 1951–57 showed that overwintered adults first appear between 1st and 14th May and may be present as late as 23rd June, with peak populations between 20th May and 8th June. Most eggs were laid by the end of May. First-instar larvae were first observed on 30th May, but were possibly present a fortnight earlier, and last-instar larvae were observed as late as 30th June; maximum larval populations occurred between 6th and 16th June. The larval stage lasted about 17 days. Both adults and larvae fed only on *A. piceae* [*cf.* **48** 13], and the eggs were preferred, though the adults and older larvae consumed some nymphs and adults. When fully fed, the fourth-instar larvae crawled down the trunk or dropped from the branches close to it and entered the soil beneath the litter, where they pupated in cells 3–5 days later. The pupal stage lasted about two weeks, and newly emerged adults were present on the trees over a maximum of 35 days between 11th July and 22nd August; each is probably active for about a month before entering the soil for overwintering. No disease organisms or parasites were found attacking *L. erichsonii* in Canada [*cf.* **42** 281], but an ant, *Myrmica lobicornis fracticornis* Emery, was observed feeding on a larva. Winter mortality appeared not to be a serious limiting factor, even when weather conditions were severe.

Population surveys, carried out by sampling methods that are described, showed an increase from the hiemosistens to the aestivosistens generations of *C. piceae* averaging 186 per cent. in the absence of *L. erichsonii* and a decrease averaging 61 per cent. in its presence. *L. erichsonii* is more effective in control than is *Leucopis* (*Neoleucopis*) *obscura* Hal. [*cf.* **47** 121] because its peak larval period occurs earlier, when *C. piceae* is also most abundant, and because it preys on the eggs. This has resulted in an almost complete loss of the aestivosistens generation of *C. piceae*.

KELLEHER (J. S.). **Life-history and ecology of** *Hylemya planipalpis* **(Stein) (Diptera: Anthomyiidae), a root maggot attacking radish in Manitoba.** —*Canad. Ent.* **90** no. 11 pp. 675–680, 7 refs. Ottawa, 1958.

Hylemyia planipalpis (Stein) occurs throughout western North America and is the principal root maggot attacking radish in Manitoba [*cf. R.A.E.*, A **39** 433], where its bionomics were studied in 1953–54 and 1955–56.

Winter is passed in the pupal stage, and adults of this generation emerged between the last week of May and mid-June, mostly in the first few days of the period. First-generation adults emerged at the end of June or in the first week of July, and emergence of second-generation adults in cages reached a peak during the first week of August in 1953. Overwintering puparia were formed after the third week in August. There are probably three generations each year, but all stages are usually present throughout

the growing season. Caged females laid an average of 41 eggs each, and the preoviposition and oviposition periods averaged 11 and 13 days, respectively. Adult females survived for an average of 16 and males for 12·1 days, with maxima of 40 and 30 days. A female caged with a male during the preoviposition period laid 109 fertile eggs. The egg stage, the first, second and third larval instars and the pupal stage lasted for averages of 2·1, 3·1, 3·5, 10 and 13 days, respectively. Eggs were usually laid just below the surface of the soil in groups of up to three or, occasionally, 20, though they were sometimes found singly on the petioles. They were usually first observed about the second week of June, when larvae were also found, and were not abundant until second-generation adults began to oviposit in mid-July or early August. In 1954 and 1956, 80–90 per cent. of the radishes in field plots were infested in late August, but infestation did not exceed 25 per cent. at any time in 1953 or 1955. Other food-plants are noted.

The Cynipid, *Trybliographa rapae* (Westw.), which parasitises the larvae, and the Staphylinid, *Aleochara bilineata* Gylh., which attacks the pupae, were reared sporadically from mass cultures of *H. planipalpis* and *H. cilicrura* (Rond.) [*cf.* **47** 88]; mortality rarely exceeded 20 per cent. Large numbers of possible and potential predators, of which the most abundant were the Carabids, *Bembidion quadrimaculatum oppositum* Say and *Agonoderus comma* (F.), were taken in pitfall traps. *Bembidion* was particularly abundant among radish infested with eggs, and in the laboratory both predators readily consumed eggs of *H. planipalpis*.

H. cilicrura was also reared each year from radish, though in considerably smaller numbers than *H. planipalpis*, together with a few adults of *Muscina stabulans* (Fall.) and *M. assimilis* (Fall.).

Riegert (P. W.). **Humidity reactions of** *Melanoplus bivittatus* **(Say) and** *Camnula pellucida* **(Scudd.) (Orthoptera: Acrididae): reactions of starved and of moulting grasshoppers.**—*Canad. Ent.* **90** no. 11 pp. 680–684, 15 refs. Ottawa, 1958.

The following is virtually the author's summary. The humidity reactions of starved adults of *Melanoplus bivittatus* (Say) and *Camnula pellucida* (Scudd.) were tested in an olfactometer over a four- or five-day starvation period. A reduction in the intensity of the normal dry preference was observed after 24 or 36 hours of fasting. A wet preference, exhibited after three or four days of starvation, was maintained until death. Nymphs of both species showed a normal preference for dry air until about 20 hours before moulting. Thereafter a preference for the moister atmosphere became evident and was maintained throughout ecdysis and for a few hours following it. A preference for dry air was evident again about 12 hours after moulting was completed. After 72–96 hours of starvation at 30°C. [86°F.] and 40 per cent. relative humidity, the grasshoppers lost an average of 40 per cent. of their normal live weight, 45 per cent. of the body water and 57 per cent. of the body fat.

Brown (C. E.). **Dispersal of the pine needle scale,** *Phenacaspis pinifoliae* **(Fitch), (Diaspididae: Homoptera).**—*Canad. Ent.* **90** no. 11 pp. 685–690, 8 refs. Ottawa, 1958.

The methods by which *Phenacaspis pinifoliae* (Fitch) spreads from tree to tree in a localised area of pines were investigated in Canada during 1951–57. Measurements of the distances from isolated parent females for which

settled nymphs had travelled, made on lightly infested Scots pine [*Pinus sylvestris*] in isolated, sheltered situations in Saskatchewan in 1951 and 1952, showed that female nymphs travelled about 11 cm. and males about 2·6 cm. In a laboratory experiment in which twigs on which nymphs were emerging were placed at the mouth of a wind tunnel and the fans operated for 48 hours, nymphs were carried by a wind of 2·5 miles per hour for a maximum distance of 72 in. In a field experiment in Alberta, in which adhesive traps were set up round an isolated clump of infested lodgepole pine [*P. contorta*] and at various distances from it, large numbers of nymphs were transported for short distances, most being caught on the traps nearest the trees; in another trap experiment, nymphs were carried downwind from a heavily infested stand for a distance of $1\frac{3}{4}$ miles, the farthest tested. It is concluded that wind is the most probable means of dispersal from tree to tree within a stand and that successful establishment may occur from wind-blown nymphs when distances are not too great. Carriage on nursery stock is the most likely means of dispersal to widely separated localities [*cf. R.A.E.*, A **43** 74].

Thomson (H. M.). **The effect of a Microsporidian parasite of the spruce budworm, *Choristoneura fumiferana* (Clem.), on two internal Hymenopterous parasites.**—*Canad. Ent.* **90** no. 11 pp. 694–696, 4 figs., 2 refs. Ottawa, 1958.

During studies of a disease of *Choristoneura fumiferana* (Clem.) caused by *Perezia fumiferanae* in Canada [*cf. R.A.E.*, A **44** 290], the organisms were occasionally found in the same host larva as one or other of the Hymenopterous parasites, *Apanteles fumiferanae* Vier. and *Glypta fumiferanae* (Vier.), and their effect on them was therefore investigated. Examination of crushed preparations of parasite larvae from infected hosts showed them to contain large numbers of spores of *Perezia*, which were confined to the gut lumen. The number of spores present appeared to be directly correlated with the intensity of infection in the host larva; where this was heavy, the parasite gut, which is blind, was almost completely filled with spores, whereas the guts of larvae from uninfected hosts contained only fragments of host tissues. The proportion of parasite larvae that failed to complete their development was considerably higher among those from infected than those from uninfected host larvae. A possible explanation for the increased mortality is that the presence of spores prevents the larvae from storing enough food to sustain them during pupation, since D. S. Grosch has found evidence that parasite larvae of this type store food in the midgut.

Putman (W. L.). **Mortality of the European red mite (Acarina: Tetranychidae) from secretion of peach leaf nectaries.**—*Canad. Ent.* **90** no. 12 pp. 720–721, 2 refs. Ottawa, 1958.

Every spring there is some mortality among the immature stages of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) on peach in the Niagara Peninsula of Ontario, and, although it is sometimes negligible, it reached 80 per cent. in some orchards in the cold wet spring of 1949. Counts among samples of at least 1,000 mites from young shoots in May 1957 showed mortality to be 53 per cent. on peach but only 7 and 8 per cent. on prune and apple. The mortality on peach is attributed to the nectar secreted by nectaries on the edges of the leaves near the petioles; there are similar.

but considerably less active, nectaries on the leaves of prune, but none on apple. Secretion begins when the leaves are between two-thirds and three-quarters grown and gradually ceases when they are fully expanded. Larvae of *P. ulmi* hatching from overwintered eggs congregate on the lower surfaces of the small leaves at the base of the shoots, often near the nectaries. It was thought that the mites might be killed by nectar diffusing over the base of leaves remaining wet after rain, and in a test in which 50 mites in different stages were each covered with small drops of water to which the secretion from 2–4 nectaries was added, all died in 24 hours, without moving from their original positions. In another test in which mites in groups of 20 were covered with small drops of 0·5–10 per cent. sugar solution, concentrations of 2·5 per cent. or more caused complete mortality in 24 hours, though one mite survived contact with 1 per cent. solution and six with 0·5 per cent.; mortality in the control groups did not exceed 5 per cent. Since the viscosity and, presumably, the sugar content of the nectar and the volume of the drops of both nectar and sucrose solution all varied considerably, no direct comparison can be made between the two liquids; in both, the critical factor appeared to be the thickness of the sticky film formed on drying, and mortality is probably due to the mechanical effect of this, since other insects feed freely on the nectar both in the orchard and in the laboratory [*cf. R.A.E.*, A **45** 7]. Mortality caused by nectar is negligible among mites of later generations, which are confined to mature leaves.

Rivard (I.). **Influence of humidity on mortality and rate of development of immature stages of the grain-infesting mite** *Tyrophagus castellanii* **(Hirst) (Acarina: Acaridae) reared on mould cultures.**—*Canad. Ent.* **90** no. 12 pp. 721–724, 5 refs. Ottawa, 1958.

The following is virtually the author's summary. When *Tyrophagus castellanii* (Hirst) was reared on a culture of *Aspergillus* sp. at 77°F. by a method already noticed [*cf. R.A.E.*, A **47** 441], no eggs hatched at 60 per cent. relative humidity, and mortality during the incubation period was close to 40 per cent. at 70, 80, 90 and 100 per cent. Mortality during the larval stage was about 5 per cent. at 80 and 90 per cent. relative humidity and reached 12 per cent. at 70 and 100 per cent., whereas almost 10 per cent. of the mites died in the protonymphal stage at each humidity and all deutonymphs completed their development. Total mortality was 50 per cent. at 80 and 90 per cent. relative humidity and almost 60 and 70 per cent. at 70 and 100 per cent. relative humidity, respectively. The incubation period lasted 5·5 days in the range 80 to 100 per cent. relative humidity but was half a day longer at 70 per cent. Durations of the larval and nymphal stages together averaged 12·8, 8·4, 6·7 and 7·3 days at 70, 80, 90 and 100 per cent. relative humidity, respectively. The total length of time required to reach the adult stage varied from 12 days at 90 per cent. relative humidity to 19 days at 70 per cent., with the males always developing slightly faster than the females. About 54 per cent. of the mites reared were females.

Hikichi (A.) & Wagner (H.). **A technique for rearing the red-banded leaf roller,** *Argyrotaenia velutinana* **(Wlkr.) (Lepidoptera: Tortricidae), during the winter.**—*Canad. Ent.* **90** no. 12 p. 732. Ottawa, 1958.

Argyrotaenia velutinana (Wlk.) has of recent years become increasingly injurious and difficult to control on apple in Ontario, and a method for maintaining a supply of larvae for tests of insecticides in winter was devised.

Webbed leaves containing full-fed larvae were collected in autumn and kept in cans covered with wire screen at outdoor temperatures in the insectary. In November, after the larvae had pupated, they were transferred to rearing cabinets kept at 77°F. and a relative humidity of 64 per cent. by day and 70 per cent. by night. The adults emerged after seven days and were collected daily and confined in groups of 50 or more in cylindrical wire-screen oviposition cages. These were 4 in. in diameter and 7 in. high, were lined with waxed paper (on which the females oviposited readily), and were kept near a window at about 72°F. Pieces of cotton-wool moistened with water and a 10 per cent. solution of molasses were provided. Pieces of the paper bearing egg-masses were cut out and transferred to covered petri dishes each containing one drop of water. The eggs hatched in 5–6 days at 77°F., and the newly hatched larvae were transferred to runner-bean plants in pots by jarring the dish or paper so that they lowered themselves on threads. The plants were kept to a height of 12 in. and enclosed in a box (3 × 6 × 1½ ft.) covered with a sheet of transparent plastic and exposed to continuous illumination; about 100 plants were sufficient to rear 400 larvae. The larvae pupated after 24 days at 70–75°F., and the webbed leaves containing the pupae were removed daily and placed in rearing cans covered with insulating board, in which a glass vial was inserted. The cans were left near a window, and the moths on emerging flew into the vials, from which they were transferred to oviposition cages. Four generations were reared without diapause or undue variations in development between November and April.

Noble (M. D.). **A simplified clip cage for aphid investigations.**—*Canad. Ent.* **90** no. 12 p. 760, 1 fig., 1 ref. Ottawa, 1958.

The materials used in the trap described are acrylic plastic tubing, a metal hair-curl clip, foam rubber, a cork to fit the tubing, and muslin, and instructions are given for assembling it. It is quickly applied, easily filled with aphids of restless species, and leaves a minimum of damage after it has been on a leaf for a week.

Graham (A. R.). **Effectiveness of two introduced parasites of the larch casebearer, *Coleophora laricella* (Hbn.) (Lepidoptera: Coleophoridae), in Ontario.**—*88th Rep. ent. Soc. Ont. 1957* pp. 37–41, 2 figs., 2 refs. [Guelph, Ont.] 1958.

Dissection of larvae of *Coleophora laricella* (Hb.), obtained in April–May 1957 from larch growing in 56 localities over an area of 65,000 sq. miles in southern Ontario, showed that the parasite, *Agathis pumila* (Ratz.), which had been liberated at four points there in 1935–41 [*cf. R.A.E.*, A **33** 143], had become established throughout the region, although infestation by *Coleophora* was light and the larch stands discontinuous. The parasite possibly reached the extreme north-west of the survey area from a release in Michigan in 1956, rather than from those made in Ontario. The average degree of parasitism increased from 41 per cent. south of 43° and 15 per cent. north of 46°N. lat. to 67 per cent. between 44 and 45°, whereas the average mortality of the casebearer from all other factors during the winter ranged from 2 per cent. south of 43° to 32 per cent. north of 46°, and it is concluded that *A. pumila* is the most effective agent controlling *Coleophora* in Ontario south of Lake Superior. *Chrysocharis laricinellae* (Ratz.), introduced at the same time, was also recovered, but it needs a high host population for effective reproduction and had spread for a maximum of 42

miles since 1934. There were indications that birds destroyed up to 21 per cent. of the overwintering larvae of *Coleophora* along their migration routes.

HEIMPEL (A. M.). **Notes on methods for rearing two Canadian forest insects.** —*88th Rep. ent. Soc. Ont. 1957* pp. 42–43, 2 refs. [Guelph, Ont.] 1958.

Laboratory stocks of *Pristiphora erichsonii* (Htg.) were reared in Ontario from collections of cocoons of the current or past year; these were stored in vermiculite kept moist with 10 per cent. sodium propionate in water and maintained at 70–72°F. and 65 per cent. relative humidity until mid-October, after which the temperature was lowered at the rate of 2° per day to about 34°F., maintained at this level, with a relative humidity of about 82 per cent., until mid-January and then increased by 2° per day. The cocoons were kept at about 70° from 1st February until adult emergence, and the newly emerged females were caged on 6-ft. larch saplings that had been brought into the greenhouse at the beginning of January and received extra light from sunset to 10 p.m. and from midnight to 1 a.m. each day, to induce the production of shoots. These reached the minimum length for oviposition (1 in.) in about 30 days, and the caged females oviposited on them almost immediately. Hatching began 12–14 days later, and the larvae were reared on larch foliage that had been collected in August and stored at 14°F. until needed.

Larvae of *Malacosoma disstria* Hb., required for experiments in December–May, were reared from egg-bands that were collected and kept at 32°F. until early December. They were then put on filter paper in petri dishes, brought to 70–72°F. and moistened twice daily. The larvae hatched in 2–6 days and could be fed on lettuce leaves for two instars, but they died in the third instar unless transferred to normal food within 48 hours. They were, therefore, moved during the second instar to shoots of pin cherry [*Prunus pensylvanica*], obtained from saplings that had been kept at a temperature of 65–70°F. from November, with artificial light from sunset to 10 p.m. each day, with the result that leaves of suitable size were available in about a month.

PHILLIPS (J. H. H.). **The tarnished plant bug, *Liocoris lineolaris* (Beauv.) (Hemiptera: Miridae), as a pest of peach in Ontario: a progress report.** —*88th Rep. ent. Soc. Ont. 1957* pp. 44–48, 11 refs. [Guelph, Ont.] 1958.

The following is based on the author's summary. *Lygus* (*Liocoris*) *lineolaris* (P. de B.) has caused a gummy scarring of peach fruits in the Niagara district of Ontario for many years. Investigations in 1957 showed that the overwintered adults and the first-generation nymphs occurred almost exclusively on red clover [*Trifolium pratense*], alsike clover [*T. hybridum*] and lucerne. Adults of the first generation dispersed to various other plants between mid-June and early July, and nearly all the injury that was visible on peaches at harvest occurred during that period. Controlled feeding tests supported the view that most of the injury was produced by adults of this generation, since adults collected when the first generation were maturing caused injury to the developing fruits similar to the scarring most commonly seen in peach orchards. In preliminary experiments, a spray of 2 lb. 50 per cent. DDT per 100 gal., applied on 17th June, when the adults of the first generation were beginning to disperse, reduced injury by about 50 per cent.

Welch (H. E.). **Test of a nematode and its associated bacterium for control of the Colorado potato beetle** *Leptinotarsa decemlineata* **(Say).**—*88th Rep. ent. Soc. Ont. 1957* pp. 53–54, 1 ref. [Guelph, Ont.] 1958.

A culture of an undetermined nematode, related to *Neoaplectana chresima*, and an undescribed bacterium associated with it, originating from diseased larvae of the codling moth [*Cydia pomonella* (L.)] in the United States [*cf. R.A.E.*, A **45** 409], was obtained from S. R. Dutky in May 1957, reared on larvae of *Galleria mellonella* (L.) [*cf. loc. cit.*] and tested for control of *Leptinotarsa decemlineata* (Say) near Belleville, Ontario. In the laboratory, 85–100 per cent. of larvae and adults that were infected died within 48 hours at 70°F. In field plots of heavily infested potato, on which no natural infection of larvae or adults was found, about 20,000 nematodes in the ensheathed stage were applied per plant in a spray on the evening of 27th June; they were not damaged by this method of application. Counts on 2nd July showed decreases of 35 and 21 per cent. in the average numbers of adults and larvae of *L. decemlineata* per plant in the treated and untreated plots, respectively, the latter reduction not being significant. Recovery of nematodes from dead insects showed that infection had occurred. Many of them had probably been washed from the plants by a fall of 1·5 in. rain on 29th June, which destroyed beetle larvae on the untreated plots.

Berube (J. A. C.). **Note on rearing the red-backed cutworm,** *Euxoa ochrogaster* **(Guen.), in mass.**—*88th Rep. ent. Soc. Ont. 1957* p. 57. [Guelph, Ont.] 1958.

Euxoa ochrogaster (Gn.) was reared in the laboratory in Canada from batches of 1,000–1,500 eggs, which were put on wet blotting paper at a temperature of 70°F. and hatched over a period of 72 hours after a pre-incubation period of 3–4 weeks at 72°F. and a storage period of six weeks at 34°F. The larvae were fed on lettuce, in glass dishes for seven days and then on trays containing 0·5 in. sterilised dry sand, until pupation, which occurred after a total of about four weeks, at 76°F. The pupae were kept in moistened vermiculite, and they gave rise to adults in about 11 days at 70–76°F. The cultures were maintained at 65 per cent. relative humidity, and there was about 10 per cent. mortality of larvae in the first seven days and 15 per cent. later. Adults for a stock culture were transferred to one-gallon cans that had a base of 8-mesh galvanised wire netting, which was buried 0·75 in. deep in a tray of sand. The moths were kept in darkness and fed with 10 per cent. honey in distilled water from a wick, and the eggs were laid on the sand after a mating period of 3–4 days and removed from it by sifting.

Briand (L. J.). **Note on overwintering of** *Adoryphorophaga aberrans* **(Towns.), a Tachinid parasite of the Colorado potato beetle.**—*88th Rep. ent. Soc. Ont. 1957* p. 57. [Guelph, Ont.] 1958.

Doryphorophaga (*Adoryphorophaga*) *aberrans* Tns., a widely distributed parasite of *Leptinotarsa decemlineata* (Say) in North America, has two generations a year. In the summer, the adults larviposit on the host larvae, and pupation takes place in these after they have died. It was not known how the parasite overwinters. In 1958, *D. aberrans* was reared from adults of *Leptinotarsa* in Canada in April. The beetles had emerged from hibernation and showed no symptoms of parasitism for about ten days, after which

they died. The larvae pupated inside them. This suggests that the overwintering parasite larvae do not become full-fed until after the hosts leave hibernation.

Hicks (S. D.). *Brachyrhinus raucus* (F.) **in Ontario.**—*88th Rep. ent. Soc. Ont. 1957* p. 58. [Guelph, Ont.] 1958.

Otiorhynchus (*Brachyrhinus*) *raucus* (F.) was collected on nursery stock of *Picea pungens*, *Juniperus communis* and *J. chinensis* in Halton County, Ontario, in June 1954, on nursery stock of *Thuja occidentalis* in the same area in 1957 and on wild raspberry (*Rubus* sp.) and seedlings of *Acer negundo* in Ottawa in June 1955, which confirms the establishment of this weevil in Ontario [*cf. R.A.E.*, A **38** 3]. In 1957, it emerged from hibernation in spring, increased in numbers and was numerous from the second week of August to the first week of September in Ottawa, where there was evidently an abundant colony on 15 acres of light sandy loam.

Bonnemaison (L.). **Le charançon des siliques** (*Ceuthorrhynchus assimilis* **Payk.). Biologie et méthodes de lutte.**—*Ann. Epiphyt.* **8** (1957) no. 4 pp. 387–543, 68 figs., 7 pp. refs. Paris, 1958.

Although *Ceutorhynchus assimilis* (Payk.) had long been known in France as an occasional pest of cruciferous vegetables grown for seed, it was not until 1951 that it caused serious damage to rape. The outbreak occurred in northern France and the Paris region, and yields were reduced by 30–40 per cent. Damage subsequently spread to rape and turnip rape in all areas in which these crops were grown, with the exception of those with a maritime climate. The adults and larvae of the weevil are described, and an account is given of studies on its bionomics and control made in 1951–56 [*cf. R.A.E.*, A **42** 407–408]. The following is based partly on the author's summary of the results.

The adults hibernated under bushes, among dry grasses along roads or ditches, or even in light soil if it was not too damp, from late July or early August until late March or April of the following year. Those hibernating in sunlit places sometimes resumed activity as soon as maximum shade temperatures reached 8–9°C. [46·4–48·2°F.], but hibernation usually continued until heavy rain in March or April provided sufficient moisture and maximum shade temperatures reached 15°C. [59°F.] for several days. After hibernation, the beetles remained lethargic for a few days, feeding on crucifers in the vicinity, and then migrated to winter rape and turnip rape. Migration was most active in sunshine at temperatures of at least 17·5°C. [63·5°F.], was impeded by strong winds, and occurred after other insects injurious to rape had appeared on the crop. *C. napi* Gylh. appeared between 8th February (1955) and 20th March (1951), *Meligethes* spp. between 11th March (1954) and 5th April (1951) and *C. quadridens* (Panz.) between 23rd March (1953) and 8th April (1952). The main migration of *C. assimilis* occurred on 19th April, 16th–21st April, 20th–26th April and 23rd–30th April and between 28th April and 10th May in the years 1951–55, respectively. Migration ceased by mid-May when warm weather set in at the end of April or early May, but continued until the end of June or even later if the temperature did not exceed 17·5°C., if strong winds persisted or if there was drought. The adults settled on the flowering stems at first, but moved within a few days to buds or young leaves for feeding, then to young pods and finally to pods in all stages of development. Females constituted 22–37 per cent. of the population on rape. Pairing occurred as soon as the fields

were infested, and the first eggs became mature between 21st April and 10th May, although females that had not oviposited were collected in the field as late as mid-July. Up to 241 eggs per female were laid in the laboratory, with an average of 77, but the average was only 24 in the field. The maximum and mean life-spans in the laboratory were 125 and 69 days, respectively, and both fecundity and length of life were diminished when feeding was confined to the pods. Eggs were laid only in the pods, of which those of rape (especially those about 1–2½ in. long) were preferred to those of turnip rape, and was facilitated by the presence of injuries. The beetles moved to spring rape when winter rape had finished flowering, but damage to this was less severe. The egg and larval stages lasted averages of 10–12 and 22–26 days, respectively; the period between the migration of the larvae to the soil for pupation and the emergence of the adults was 12 days at 25·5°C. [77·9°F.] and 50 days at 12°C. [53·6°F.]. Adults emerged on 29th June in 1953 and 12th July in 1951; they fed on young tissues of wild or cultivated crucifers and sought hibernation quarters between 10th July and 15th August, although a few persisted in the fields until mid-October.

Observations on mortality showed that hibernating adults were not adversely affected by prolonged cold during the severe winter of 1955–56, but up to 70 per cent. of individuals died if the ground was parched when the larvae were migrating to the soil for pupation or when the adults were emerging. Large numbers of freshly emerged adults were also killed by storms, and wet weather in winter and spring, coastal climates, and strong winds were unfavourable for their survival. Within the pods of winter rape, 20 per cent. of larvae died from causes other than parasitism, and the rate was higher in the pods of other crops. The most important parasite near Paris was *Perilitus melanopus* (Ruthe), which hibernates as a larva in the adults of *C. assimilis* of both sexes and completes its development rapidly when the weevils resume activity in spring. In the spring of 1953, 50–60 per cent. of the weevils in daily collections on turnip rape were parasitised by this Braconid [*cf.* **43** 29], as compared with only 1–3 per cent. on rape little more than ¼ mile away. A Pteromalid, *Trichomalus perfectus* (Wlk.), adults of which appeared in mid-April, was of some importance as an ectoparasite of the larvae; it has apparently been misidentified as *T. herbidus* (Wlk.) in the literature [*cf.* **43** 29]. Other parasites recorded in the area were the Braconids, *Diospilus oleraceus* Hal., *D. morosus* Reinh., *Bracon discoideus* Wesm. and *Triaspis* (*Sigalphus*) *obscurellus* (Nees), the Pteromalid, *Xenocrepis pura* Mayr, an Ichneumonid of the genus *Tersilochus*, a Mymarid, *Patasson* (*Anaphoidea*) *declinata* (Soyka), which parasitised the eggs, and nematodes.

The amount of damage caused by *C. assimilis* is variable, depending on the plant and its state of development at the time of the spring migration. Up to 15–20 per cent. of the developing ovules are destroyed after a mass invasion, but the incidence rapidly diminishes; damage to the older seeds is more serious. The larvae injure 8–15 per cent. of the seeds, destroying 2·5 seeds each in a dry season, but the destruction may reach 30–60 per cent. in wet seasons, when invasion by fungi increases the losses. Additional damage is caused by *Dasyneura brassicae* (Winn.), and the literature on the relation between this Cecidomyiid and *C. assimilis* is discussed [*cf.* **47** 460, etc.]. Adults of the overwintered generation of *D. brassicae* oviposited at Versailles between 20th April and 1st–10th May, before *C. assimilis* began to oviposit, and laid their eggs in pods showing fissures of any kind or even feeding injuries caused by the adult weevils, whereas those of the first generation usually oviposited through the oviposition holes made by the latter, and in this case eggs of the two insects were found in juxtaposition within the

pods. Damage can be reduced by cultural measures, including the replacement of winter rape by turnip rape, which is less severely injured, or other winter crucifers or by spring rape, and using late-flowering varieties of the latter or late sowing dates, so that the pods escape infestation by *C. assimilis* and also by *D. brassicae*. Ploughing crop remains under immediately after harvest and destroying cruciferous weeds deprive the newly emerged adults of food and increase mortality during hibernation. Mechanical control methods are of little value.

In tests of insecticides, soil treatment with dusts of BHC or dieldrin at rates of 9 and 4·5 lb. per acre gave only 55 and 65 per cent. reduction in adult emergence, respectively, and sprays of parathion and lindane [almost pure γ BHC] at about 0·5 lb. active ingredient per acre gave unsatisfactory results against eggs and larvae in the pods [*cf.* **41** 431; **42** 407], except against very young larvae. Demeton also proved unsatisfactory, but toxaphene in an emulsion spray at about 2 lb. active ingredient per acre gave almost complete mortality. The use of such treatments is practicable only on a small scale, and chemical measures against the adults are the only ones of value for large-scale use, although the beetles are naturally resistant to nearly all insecticides and migrate to rape at a time when bees are active and the crop has grown too tall for ease in application. Many insecticides were tested against them in the field and laboratory in 1951–56. The best results were given by sprays of dieldrin and sprays or dusts of parathion, toxaphene or BHC; sprays of dieldrin and toxaphene were the most persistent, but a 2 per cent. methyl-parathion dust had the quickest action. In large-scale tests in 1954, a spray affording 0·45 lb. dieldrin per acre gave the best control, irrespective of temperature, and γ BHC in dust or spray was more effective than parathion at temperatures below 15°C. and inferior to it at higher temperatures. The effectiveness of toxaphene, tested in 1955, also varied with temperature; the rate of application of the emulsion spray had to be increased from 3·38 lb. active ingredient per acre at 18°C. [64·4°F.] to 4 lb. at lower temperatures for equivalent kills, and the concentration of dusts raised from 10 to 20 per cent. Residues from toxaphene sprays and dusts persisted for 7–13 and 3–10 days, respectively.

It is concluded that control of *C. assimilis* on winter rape can best be achieved by a spray applied in late April to field margins, with dieldrin, BHC or parathion as the toxicant if fewer than 100 flowers per sq. m. are open, or toxaphene if the number is greater and hazards to bees must be considered [*cf.* **43** 182, etc.], followed by an application of toxaphene to the crop in early May and a second application to the margins 7–10 days later. The effectiveness of these measures depends largely on the temperature prevailing after spraying. Sprays are more persistent than dusts, but dusts can be used when speed of application is of importance.

Greathead (D. J.). **Observations on two species of *Systoechus* (Diptera: Bombyliidae) preying on the desert locust, *Schistocerca gregaria* (Forskål), in eastern Africa.**—*Entomophaga* **3** no. 1 pp. 3–22, 30 figs., 18 refs. Paris, 1958. (With a summary in French.)

The larvae of *Systoechus somali* Oldroyd [*R.A.E.*, A **38** 353] and *S. aurifacies* Greathead [**47** 54] feed on the eggs of *Schistocerca gregaria* (Forsk.) in East Africa. They are almost identical in appearance, and it is difficult to rear adults from them, since they must be disturbed as little as possible, to avoid desiccation from abrasion of the delicate cuticle, and their humidity requirements are exacting. Characters permitting differentiation of the larvae were therefore sought, and comparison of third-instar material of these species and of *Systoechus pallidulus* (Wlk.) and *S.*

autumnalis (Pall.) showed interspecific differences in the shape of the cephalic sclerites. The pupae of the four species were readily distinguished. The distinguishing characters are described for both stages.

The percentages of egg-pods attacked by *S. somali* at 17 sites in Ethiopia, Somalia and Kenya in 1953–54 ranged from 62 at El Rago, in the Ogaden region of Ethiopia [*cf.* **38** 353], to 1·2 at Ado, in the same area, and was 1·3 at Wajir, in Kenya, which was the only site where a quantitative assessment based on a sampling system could be made. The high figure for El Rago was based on a small number of egg-pods, but 59 per cent. attack was found at Shillave, also in the Ogaden, which is considered a more reliable indication of the maximum rate. The soils at the majority of the sites were of coarse sand or gravel, which covers the egg-pods, but there was little evidence that pods in clay soil, which does not, were more heavily attacked. The distribution of *S. somali* was of a local nature, and larvae were found in only one of three egg-fields associated with the Bombyliid out of 11 examined in October–November 1953 between the Webbi-Shabelli river and the Kenya border, in the Upper Juba province of Somalia, and in only two out of 12 egg-fields examined in May 1955 in the Turkana district of Kenya. Attack within an egg-field was equally sporadic.

The larvae consume about 8–10 eggs each during their life, and eight or more would thus be expected to destroy the contents of a pod, but single larvae were found in 43 and 66 per cent. of the pods examined at Milima Tatu and Tiya, respectively, in Kenya, two in 23 and 19 per cent., three in 12·5 and 9·5 per cent., four in 8·9 and 0 per cent., five in 6·8 and 4·7 per cent., and 6–16 in 6·6 and 0 per cent. At Shillave, however, 20–40 larvae per pod were common, and the maximum was 66. The larva appeared to puncture an egg and suck out the contents, leaving the chorion dry and collapsed, so that no general putrefaction occurred, such as followed attack by other egg-predators, notably *Stomorhina lunata* (F.), which was present at all except two of the sites and occurred in 6–55 per cent. of the pods there [*cf.* **41** 242]. The second larval instar was the youngest stage of *Systoechus somali* observed; feeding and growth were rapid in this and the third instar, and four days is probably the minimum duration of the feeding period. The egg and feeding stages together occupy about seven days, after which the larva rests in a soil cavity near the egg-pod. The duration of the resting period has not been ascertained in the field, but larvae remained unchanged for up to three years in the laboratory at 25–30°C. [77–86°F.] and pupated only when the soil was moistened [*cf.* **38** 353]. Adults were seen in the Ogaden region and in Somalia only in October–November 1953 and October 1954, at times of egg-laying by *Schistocerca gregaria*. The females appeared to oviposit, but no eggs were found.

Larvae of *Systoechus aurifacies* were observed in 22 out of 80 pods in a scattered egg-field at Emberemi, near Massawa, Eritrea, in February 1954 [*cf.* **47** 54]. Three of the 22 each contained two larvae, and the others a single one. Most of the larvae were in the third instar, and these gave rise to adults in 35–43 days when kept in damp sand in glass tubes in the field, after a pupal stage lasting about 6–7 days. The life-cycle of *S. aurifacies* is similar to that of *S. somali*. Notes are included on the rearing of these Bombyliids.

Biliotti (E.). **Les parasites et prédateurs de** *Thaumetopoea pityocampa* **Schiff. (Lepidoptera).**—*Entomophaga* **3** no. 1 pp. 23–34, 6 figs., 1 map, 20 refs. Paris, 1958. (With a summary in English.)

Investigations on the natural enemies of the pine processionary, *Thaumetopoea pityocampa* (Schiff.), have been carried out in France since 1953,

mostly on the Atlantic and Mediterranean coasts, in the Maritime Alps and in Provence, and also in Corsica. A list of the known parasites and predators of the Notodontid and the birds that attack it is given, showing those found in the investigations and followed by notes on relative importance.

Parasites attacked 60–100 per cent. of the egg-masses laid in 1956 at 12 sites, but the percentages of eggs destroyed varied from 3·4 to 28, suggesting that although the egg-masses are easily discovered, their penetration is hindered by the scales covering them. In some areas, only a single species of egg-parasite was present, such as *Trichogramma* sp. in the Sarthe, at the northern limit of distribution of *Thaumetopoca*, but a complex of species generally occurred, including *Ooencyrtus pityocampae* (Merc.), *Tetrastichus tibialis* (Kurd.), *Trichogramma* sp. and, in the Gironde and Var, *Anastatus bifasciatus* (Boy.). At an altitude of 4,265 ft. in Corsica, *Trichogramma* sp. was almost the only egg-parasite present, *O. pityocampae* constituting the remainder. Observations on the latter showed that it has two generations a year; the first is completed before the host eggs hatch, and the second appears in the following spring after hibernating as full-fed larvae in diapause. Several successive generations were reared in the laboratory, and when diapause occurred it was eliminated without exposure to cold. Only one larva developed in each host egg. Adults preferred to oviposit in eggs from which the scales had been removed.

The larvae were parasitised by the Ichneumonids, *Anomalon latro* (Schr.) and *Ichneumon rudis* Boy., and the Pteromalids, *Psychophagus omnivorus* (Wlk.) and *Dibrachys cavus* (Wlk.), but these were of little significance. The most important of the Tachinids found attacking the larvae was *Zenillia* (*Phryxe*) *caudata* (Rond.) [*cf. R.A.E.*, A **45** 44], but it was poorly synchronised with the host and the pupae suffered heavy parasitism by *D. cavus* and *Habrocytus eucerus* (Ratz.), which halved the population of the parasite at one place in March 1956. *Compsilura concinnata* (Mg.) was widely distributed, though nowhere numerous. The adults of the final autumn generation overwintered in larvae of *Thaumetopoca*, and fifth-instar larvae of the latter were also attacked. *Pales* (*Ctenophorocera*) *pavida* Mg., not previously recorded from *T. pityocampa*, was found parasitising the larvae at an altitude of 3,600 ft. in Corsica, but it was not well synchronised with the host. Pupae of the latter sometimes bore indications of attack by Bombyliids; the only one reared was *Villa* (*Anthrax*) *hottentota* (L.). *Formica rufa* L. has been cited as an important predator of *T. pityocampa*, but the only ants found attacking it were *Crematogaster scutellaris* (Ol.) and *Leptothorax recedens* (Nyl.), which preyed on the adults as they emerged. Young colonies of *T. pityocampa* were destroyed in Var by the polyphagous Syrphid, *Xanthandrus comtus* (Harris) [*cf.* **25** 326].

Vago (C.). **Virose intestinale chez la processionnaire du pin** *Thaumetopoea pityocampa* **Schiff. (Lepidoptera).**—*Entomophaga* **3** no. 1 pp. 35–37, 3 figs., 4 refs. Paris, 1958.

In addition to the polyhedral virus disease of the nuclear type recorded from larvae of *Thaumetopoca pityocampa* (Schiff.) in France [*R.A.E.*, A **43** 95], a cytoplasmic one also occurs. The polyhedra and the course of the disease are described. The virus was experimentally transmitted by the injection of purified inclusion bodies into third-instar larvae of *T. pityocampa*, and symptoms appeared 9–11 days after larvae maintained at 18°C. [64·4°F.] had ingested a suspension containing 100,000 polyhedra per cc. Mixed infections with this and the nuclear virus were common in nature, but the cytoplasmic virus predominated.

Masner (L.). **A new egg-parasite of gipsy moth** *Lymantria dispar* **(L.).**—*Entomophaga* **3** no. 1 pp. 39–44, 1 fig., 15 refs. Paris, 1958. (With a summary in French.)

Hadronotus lymantriae, sp.n., is described from five females reared from several thousand eggs of *Lymantria dispar* (L.) in eastern Slovakia. Its phylogeny is discussed, other Scelonids that parasitise the eggs of *L. dispar* are reviewed from the literature, and a key including them all is given.

Féron (M.), Delanoue (P.) & Soria (F.). **L'élevage massif artificiel de** *Ceratitis capitata* **Wied.**—*Entomophaga* **3** no. 1 pp. 45–53, 6 figs., 11 refs. Paris, 1958. (With a summary in English.)

Improvements in the method used for the mass breeding of *Ceratitis capitata* (Wied.) in France [*R.A.E.*, A **44** 143] are described. Since experiments showed that the stimulus inducing oviposition through a perforated surface is an atmosphere saturated with water vapour on the other side, special oviposition devices were used [*cf.* **45** 363], consisting of rounded containers of soft plastic (polyethylene sulphide) such as are used for the transport of hens' eggs. These were pierced with numerous holes and coloured yellow, to stimulate activity of the flies, and lined with damp muslin; the eggs were laid through the holes on to the latter. The muslin was removed every 24 hours and soaked in water, when the eggs sank to the bottom of the vessel. If necessary, they could be left there, as hatching takes place and first-instar larvae survive for several days in pure water. The oviposition cages, 18 × 12 × 12 in. in size and made of plastic mesh, with a sliding door of transparent plastic, were maintained at 25°C. [77°F.] and 80 per cent. relative humidity. Adults emerged from 95–98 per cent. of 1,000 pupae of both sexes placed in each cage, and they were supplied with disks of banana and rolls of dental cotton soaked in water. Oviposition began three days after the emergence of the first adults, and at least 2,000 eggs per day were laid between the 6th and 20th days, with a peak of more than 4,000 at about the 10th day. In some cages there was a rapid and unexplained mortality of females, but, in another, 500 females laid 7,000 eggs in 24 hours. Generally, about 10 per cent. of the eggs were sterile, and these could be detected by their greyish hue. The larvae were reared in plastic dishes on a paste consisting of 100 g. steamed, powdered and dried carrot [*cf.* **45** 108], 20 g. dried brewer's yeast, 400 cc. 0·2 per cent. benzoic acid and 10 cc. 3·65 per cent. hydrochloric acid (the last two constituents protecting against contamination by micro-organisms). Each dish was furnished with 3,500 eggs, obtained volumetrically by filtering through nylon tissue from water containing 15 per cent. glycerine. The dishes were kept at 26°C. [78·8°F.]. The larvae became full-fed in eight days, and the dishes were then placed in cabinets over drawers containing sand, in which pupation occurred. A plastic inclined plane was used to guide the larvae to the sand. The pupae were collected by sifting and kept at 26°C., and the adults emerged 9–11 days after pupation. In all, adults were obtained from about 80 per cent. of the eggs laid, and 20,000 a day could be produced by a single trained operator.

Fischer (M.). **Über die Variabilität von taxonomisch wichtigen Merkmalen bei** *Opius concolor* **Szépl. (Hym. Braconidae).** [On the variability of taxonomically important characters in *O. concolor*.]—*Entomophaga* **3** no. 1 pp. 55–66. Paris, 1958. (With a summary in French.)

The author concludes from an examination of 121 adults of the group of *Opius concolor* Szépl. reared from *Dacus oleae* (Gmel.) in Libya, Tunisia,

Algeria and Sicily and 226 reared from *Ceratitis capitata* (Wied.) in Morocco, Libya and Tunisia that there are no constant differences between examples obtained from the two hosts, that all are referable to *O. concolor* (which is a variable species), and that *O. perproximus* Silv. [*cf. R.A.E.*, A **26** 492; **30** 304], *O. humilis* Silv. [*cf.* **6** 185] and *O. siculus* Monastero [*cf.* **22** 51, 330] are synonyms of it. Ecological studies are required before it can be known whether biological races or species should be distinguished within the complex.

Benassy (C.). *Prospaltella berlesei* **How. (Hym. Aphelinidae) et son efficacité pratique en France vis-à-vis de** *Pseudaulacaspis pentagona* **Targ. (Hom. Diaspidinae).**—*Entomophaga* **3** no. 1 pp. 67–70, 7 refs. Paris, 1958. (With a summary in German.)

Pseudaulacaspis pentagona (Targ.) was kept in check on fruit trees in France for many years by the introduced Aphelinid, *Prospaltella berlesei* (How.), but it has become more injurious since about 1948, particularly on peach and, in some areas, mulberry [*cf. R.A.E.*, A **34** 362; **45** 116, etc.], despite the presence of *P. berlesei*. The use of insecticides is largely responsible in peach orchards [*cf.* **47** 210], since they kill the parasite, but they are not applied to mulberry, so that other factors must also be involved [*cf.* **47** 363]. Observations on mulberry showed that the parasite was ineffective near Lyons, but so effective in the Mediterranean area that the Coccid was almost absent. This suggested that climatic differences might be of importance. The Coccid had two generations a year, with sometimes a partial third, in the first area and three, though the third was occasionally only partial, in the second, and there were no significant differences in the rates of winter mortality between the two areas. The parasite had four generations a year near Lyons, however, the first adults emerging in late May, and five in the Mediterranean area, where emergence began in late March, at a time when the overwintered females of *Pseudaulacaspis pentagona* were resuming their activity but had not yet begun to oviposit. This early development of the parasite is responsible for its effectiveness in the latter area.

Niklas (O. F.). **Auftreten und Periodik verschiedener Krankheiten und Parasiten bei Larven des Maikäfers (*Melolontha* spec.).** [The occurrence and periodicity of various diseases and parasites of larvae of *Melolontha* spp.]—*Entomophaga* **3** no. 1 pp. 71–88, 7 graphs, 19 refs. Paris, 1958. (With a summary in English.)

In this further contribution on the causes of mortality in mixed populations of larvae of *Melolontha melolontha* (L.) and *M. hippocastani* F. at Lorsch, in western Germany [*cf. R.A.E.*, A **46** 290], the occurrence and periodicity of the various factors in 1954–57 are considered. Of the deaths that occurred in larvae collected in the field and reared in the laboratory in 1954–55, 1955–56 and 1956–57, 32·9, 28·4 and 18·8 per cent., respectively, were caused by *Rickettsiella* (*Rickettsia*) *melolonthae*, 20, 33·4 and 46·8 per cent. by bacterial diseases, 5·1, 2·8 and 6·9 per cent. by fungi (chiefly *Beauveria tenella*), 1·4, 6·7 and 2·7 per cent. by " dropsy ", 1·1 per cent. (in 1954–55) by Microsporidia (*Plistophora melolonthae*), 0·3 per cent. (in 1954–55) by flagellates (*Polymastix melolonthae*), 4·3, 10 and 12·4 per cent. by nematodes (chiefly a species of *Diplogasteroides* that was to be described by W. Rühm as *D. berwigi*, sp.n.), 0·6, 2·4 and 0·9 per cent. by

the Tachinid, *Dexia rustica* (F.), 2·8 and 0·5 per cent. (in 1955–56 and 1956–57) by the Phorid, *Megaselia rufipes* (Mg.), and 34·4, 13·5 and 11 per cent. by unknown causes, probably physiological in origin.

M. rufipes and *R. melolonthae* have been considered separately [**47** 75, 151]. Of the deaths due to bacteria, fungi, dropsy, nematodes and unknown causes that occurred in the laboratory, 58·6, 32·5, 29·4, 80·5 and 36·7 per cent., respectively, occurred during the first 30 days after collection and 15·1, 16·9, 14·8, 11·7 and 24·8 per cent. during the next 30 days. The fewest deaths took place at 121–150 days, but a second, though lower, peak of mortality was observed after 181–360 days in the deaths due to bacteria, fungi and unknown causes, and after 361–540 days in those due to dropsy. Nematodes ceased to play any part in mortality after about 120 days. The incidence of deaths from bacterial diseases was high in May–July and low in October–March, whereas deaths of unknown origin showed two peaks, in February–March and May–August, but there were wide annual fluctuations in both groups. No bacteria specific to *Melolontha* were found, nor any sporulating forms. Mortality due to these two causes could not be determined in the field, though a black-spot disease observed in April and to a less extent in July–September may have been of bacterial origin, and infections by bacteria may have resulted from injury sustained during collection or as a result of attack by other larvae. Of the deaths from fungi, 68 per cent. were caused by *B. tenella* and 21 per cent. by *Fusarium* sp. Fungous disease was commonest in July–October in the field, but in June–August and December–March in the laboratory. The larvae frequently survived until the third instar, although infected at an early stage. The aetiology of dropsy was not ascertained. Deaths due to it occurred in the laboratory mainly in July–August, with subsidiary outbreaks in October, December–January and March, but they were restricted to July–August in the field. *Polymastix melolonthae* occurred only in November in both field and laboratory, and *Plistophora melolonthae* in August–September in the field and August–November in the laboratory. Nematodes caused deaths throughout the year in the laboratory, with peaks in May and September, whereas deaths were recorded in the field in April–November, with a peak in August. *M. rufipes* was found parasitising collected larvae in July–October, with a peak at the end of August, and adults emerged in early October. *D. rustica* occurred in April–May and July–August, with a peak in July, and adults emerged in August–September [*cf.* **32** 324].

Zum IV. Internationalen Pflanzenschutzkongress Hamburg vom 8. bis 15. September 1957. [On the occasion of the Fourth International Plant Protection Congress, Hamburg, 8th–15th September 1957.]—*Z. PflKrankh.* **64** pt. 7–10 pp. 385–637. Stuttgart, 1957.

The papers of entomological interest that were here published before the opening of the Fourth International Plant Protection Congress include: **Einige Probleme der Forstentomologie in Schweden** [Some problems of forest entomology in Sweden] (pp. 392–396), by V. Butovitsch, who discusses the outbreaks of insect pests, notably *Hylobius abietis* (L.), that have resulted from the adoption of clear-felling in forests in Sweden [*cf. R.A.E.*, A **46** 141]; **Bioassay in entomological research** (pp. 498–505, 2 graphs, 22 refs.), by W. M. Hoskins, who reviews the uses of insects for determination of the amount of a toxicant in an insecticide formulation, in a deposit, in the soil or in and on plant or animal products, with special reference to the procedures and devices employed; **The susceptibility of crops to insect injury in relation to the chemical constitution of the plant**

(pp. 505–507, 4 refs.), by A. J. Thorsteinson, which is a brief review of general principles; **Der Flug von Insekten über pflanzenfreien und pflanzenbewachsenen Flächen** [The flight of insects over plant-free and plant-covered areas] (pp. 507–514, 2 figs., 10 refs.) (with a summary in English), by V. Moericke, who describes experiments in Germany, with suction traps and yellow dishes filled with water, showing that some insects attracted by the colours green and yellow (notably aphids, including *Myzus persicae* (Sulz.) and *Aphis fabae* Scop., and Psyllids) were more numerous over bare soil than over cultivated plots, whether or not these contained food-plants of the species concerned, whereas others showed a reverse reaction, and some not attracted by colour (*Macrosiphum* (*Sitobium*) *avenae* (F.), many Diptera, Hymenoptera and Thysanoptera) were at least as numerous over cultivated plots as over bare soil, whereas others (Staphylinids) were more numerous over bare soil; **Beobachtungen über schädliche Rhynchoten und Acariden an Moorbeetpflanzen im nordwestdeutschen Küstengebiet** [Observations on injurious Hemiptera and mites in the north-western coastal marsh region of Germany] (pp. 514–520, 4 refs.) (with a summary in English), by E. Meyer & R. Hellerich, who review the Heteroptera, Aleyrodids, aphids, Coccids and Tetranychids that infest rhododendron and conifers in nurseries in the region of Oldenburg; *Diprion pini* **L. als Schädling der Kiefernbestände in den Niederlanden** [*D. pini* as a pest of pines in Holland] (pp. 520–522, 7 refs.), by A. D. Voûte & J. Luitjes; **Die Kutikelpermeabilität bodenbewohnender Tipuliden-Larven** [The permeability of the cuticle of soil-inhabiting Tipulid larvae] (pp. 522–528, 4 figs., 15 refs.) (with a summary in English), by M. S. Ghilarov [Gilyarov] & L. M. Semenova, who record experiments in the Soviet Union showing that the cuticle of the larva of *Tipula paludosa* Mg. is sufficiently permeable for gaseous exchange (oxygen uptake) and transpiration to take place through it and for it to be permeated by salts, it having no epicuticular layer; **Über eine Mykose der Larven von** *Tipula paludosa* **Meig. durch** *Empusa* **sp.** [A mycosis of the larvae of *T. paludosa* due to *Entomophthora* sp.] (pp. 529–534, 5 figs., 11 refs.) (with a summary in English), by E. Müller-Kögler, who describes an infestation of the larvae of *T. paludosa* by a fungus of the genus *Entomophthora* (*Empusa*) in Oldenburg (north-western Germany); **Die Eiablage der Weizengallmücken** *Contarinia tritici* **Kirby und** *Sitodiplosis mosellana* **Géhin** [Oviposition by the wheat gall-midges, *C. tritici* and *S. mosellana*] (pp. 534–540, 9 figs., 14 refs.) (with a summary in English), by W. Speyer, who compares observations in northern Germany with those recorded in the literature and records the finding of two smaller, unidentified Cecidomyiids in the ears of wheat there; *Oscinella frit* **L. and closely allied species in England and Germany** (pp. 541–547, 2 figs., 4 refs) (with a summary in German), by W. F. Jepson & I. W. B. Nye, who discuss the larvae of *Oscinella frit* (L.) and other species of the genus that infest cultivated and wild grasses in the two countries [*cf.* **47** 166], giving diagnostic characters distinguishing larvae and adults; **Klärende Untersuchungen über das Auftreten von Blütengallmücken an der Wiesenrispe** *Poa pratensis* **L. in Deutschland** [Clarifying investigations on the occurrence of gall-midges on *P. pratensis* in Germany] (pp. 547–550, 9 figs., 8 refs.) (with a summary in English), by E. Mühle, who describes a Cecidomyiid that infests the flowers of *Poa pratensis* in Germany as *Dasyneura poae*, sp.n.; **Die Prognose von Fichtennestwicklerschäden** (*Epiblema tedella* **Cl.**) [Forecasting damage by *Eucosma tedella*] (pp. 550–554, 2 refs.) (with a summary in English), by B. Ohnesorge, who states that imminent damage to spruce by *Eucosma* (*Epiblema*) *tedella* (Cl.) in Germany can be forecast while the insect is in the egg or early larval stage from the population density of the insect, the quantity of food eaten by a single larva (about 40 needles)

and the available food-supply; **Untersuchungen über die Sexualbiologie von** *Prodenia litura* **F. in Ägypten** [Investigations on the sexual biology of *P. litura* in Egypt] (pp. 554–562, 1 fig., 7 refs.), by R. Wiesmann, who describes experiments showing that traps baited with freshly emerged females of *Prodenia litura* (F.), an important pest of cotton in Egypt, are effective in catching males of the species after sunset; **Beitrag zur Frage der biologischen Abhängigkeit der Kohlschotenmücke** (*Dasyneura brassicae* **Winn.) von dem Kohlschotenrüssler** (*Ceuthorrhynchus assimilis* **Payk.**) [Contribution to the problem of the biological dependence of *D. brassicae* on *C. assimilis*] (pp. 562–568, 14 refs.) (with a summary in English), by C. Buhl, who reviews the conflicting evidence as to the relation of oviposition by *Dasyneura brassicae* (Winn.) in rape pods to previous attack by *Ceutorhynchus assimilis* (Payk.) [*cf.* **48** 77, etc.] and records experiments in the greenhouse and field in Schleswig Holstein in which oviposition occurred only after adults of *C. assimilis* had been introduced into the cages; **Badania nad zmianami śmiertelności** *Aporia crataegi* **L. w kolejnych latach masowego pojawu (1952–1957) w Polsce** [Observations on the variable mortality of *A. crataegi* in successive outbreak years (1952–57) in Poland] (pp. 568–572, 6 refs.) (with a summary in English), by J. J. Lipa & A. Ruszkowski, who state that the intensity of infestation by *Aporia crataegi* (L.) in orchards in Poland varies locally and record observations on parasitism of the larvae, which was heavier on *Crataegus* than on apple or plum, and of the pupae, which did not vary with the food-plant; **Breeding** *Pieris brassicae* **L. and** *Apanteles glomeratus* **L. as experimental insects** (pp. 572–577, 3 figs., 4 refs.), by W. A. L. David, which is a description of laboratory techniques; **Ein Vergleich des europäischen und des nordamerikanischen Tannentriebwicklers** (*Choristoneura murinana* **(Hb.) und** *C. fumiferana* **(Clem.))** [A comparison of the European and North American fir Tortricids, *C. murinana* and *C. fumiferana*] (pp. 578–584, 4 figs., 17 refs.) (with a summary in English), by J. Franz, who compares the food-plant relations, bionomics and natural control of *Choristoneura murinana* (Hb.) on silver fir (*Abies alba* (*pectinata*)) in European countries with those of *C. fumiferana* (Clem.) on balsam fir (*A. balsamea*) in Canada; **Massnahmen zur Bekämpfung der** *Dendroctonus*-**Epidemie in den Kiefernwäldern Guatemalas** [Measures for the control of the *Dendroctonus* outbreak in the pine forests of Guatemala] (pp. 584–588, 5 figs.) (with a summary in English), by F. Schwerdtfeger, who describes silvicultural and other measures for the control of the current outbreak of *Dendroctonus adjunctus* Bldf. in the extensive forests of *Pinus rudis* in Guatemala; **Breeding the Colorado beetle under controlled conditions** (pp. 589–593, 4 figs., 4 refs.), by J. de Wilde, who describes laboratory methods of rearing *Leptinotarsa decemlineata* (Say) on young leaves of potato at any time of year; **Über die Entwicklung erhöhten Randbefalls von Ackerbohnen-Beständen durch** *Aphis fabae* **Scop.** [On the development of increased edge-infestation in plantings of broad beans by *A. fabae*] (pp. 593–599, 2 figs., 7 refs.) (with a summary in English), by H. J. Müller, who concludes from observations in Germany that the higher infestation of broad beans [*Vicia faba*] by *Aphis fabae* Scop. round the edges of a field than in the interior of it is due to the habit of the aphid of flying close to the ground when migrating to a crop; **Auftreten von Weibchen bei der anholozyklischen Form von** *Rhopalosiphoninus tulipaellus* **Theob. 1916 (Aphidoidea)** [Occurrence of females of the anholocyclic form of *R. staphyleae tulipaellus* (pp. 599–600, 1 fig., 7 refs.) (with a summary in English), by C. Martini, who records the development in November 1956 of a few oviparae, but no males, among a population of the anholocyclic form of *Rhopalosiphoninus staphyleae tulipaellus* (Theo.) reared on beet in the dark at 15°C. [59°F.]; **Zur Kenntnis von** *Hemiteles melanarius* **Grav. (Ichn.). Ein Fall**

des Übergangs vom Ekto- zum Endoparasitismus [Contribution to knowledge of *H. melanarius*. A case of transition from ecto- to endoparasitism] (pp. 600–606, 2 figs., 11 refs.) (with a summary in English), by H. Blunck & M. Janssen, who record the unexpected finding of *Hemiteles melanarius* Grav. as a parasite of the pupae of *Pieris brassicae* (L.) in Germany in 1955, the numerous hosts ascribed to it in the literature, and observations on the feeding habits of the larvae, which are at first ectoparasitic and then endoparasitic; **Ecology of stored products pests: progress of a long-term project** (pp. 606–612, 2 figs., 30 refs.), by M. E. Solomon, which is a review of recent work on the ecology of pests of stored grain in Britain carried out at the Pest Infestation Laboratory; **Auftreten und Bekämpfung einiger Obstschädlinge in Syrien** [Occurrence and control of pests of fruit in Syria] (pp. 613–619, 6 figs., 2 refs.) (with a summary in English), by F. Schneider, in which the pests dealt with are *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple and pear, *Zeuzera pyrina* (L.) and *Scolytus rugulosus* (Ratz.) on apple, *Rhynchites auratus* (Scop.) on apricot and *Caliroa limacina* (Retz.) on cherry; **Die Bekämpfung von Pflanzenschädlingen durch Saatgutbehandlung mit systemischen Insektiziden** [The control of plant pests by seed treatment with systemic insecticides] (pp. 619–625, 12 refs.) (with a summary in English), by G. Unterstenhöfer, who reviews the results of experiments in various parts of the world and concludes that phorate (Thimet) and Disyston (O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate) are very effective as seed treatments for the control of pests attacking growing plants, particularly cotton in the United States [*cf.* **46** 435; **47** 65, 245]; and **Neuere Ergebnisse der Deutschen Pflanzenschutzforschung im Gemüsebau** [Recent results of research in Germany on plant protection in vegetable-growing] (pp. 631–637, 103 refs.) (with a summary in English), by H. Bremer, which is a review of recent literature on the control of pests and diseases of vegetables in Germany up to 18th May 1957.

Baumann (G.). **Über eine durch ektoparasitische Gallmilben verursachte Gelbfleckigkeit (Sternfleckenkrankheit) bei *Prunus*-Arten.** [On a yellow spotting of *Prunus* spp. (asteroid spot disease) caused by ectoparasitic gall-mites.]—*NachrBl. dtsch. PflSchDienst* (N.F.) **11** pt. 12 pp. 246–250, 7 figs., 16 refs. Berlin, 1957. (With summaries in English & Russian.)

A yellow spotting of the leaves of *Prunus* spp. that is common in nurseries in central Germany was found to be caused by the Eriophyid, *Aculus* (*Vasates*) *fockeui* (Nal. & Trt.) [*cf. R.A.E.*, A **29** 304]. The symptoms, which have also been observed in other parts of Europe and in the United States, occurred on many varieties of plums, Myrobalan plum [*P. cerasifera*] and apricot, and to a less extent on peach. They resulted in leaf-curl, particularly on apricot, and in a curtailing of the tips of the shoots, especially on plum. Both types of damage were seen on peach. Mites were observed on the lower surface of the youngest leaves from the beginning or middle of June in 1954–57, and the infestation spread progressively to new leaves as they appeared, the older leaves gradually becoming free. Plum, with more than 50 mites in all stages per leaf, showed the heaviest infestation. When 15 individuals were placed on the two youngest leaves at the tip of each new shoot on uninfested greengage seedlings, feeding marks appeared 2–3 days later and the characteristic yellowing was present after 15 days. Feeding was generally over by the beginning or middle of August, and the numbers of mites were only 1–5 per leaf on peach, apricot and Myrobalan plum, though rather more on plum, by 20th August.

When severely affected apricot and Myrobalan plum seedlings were taken in January 1957 to a greenhouse in which fumigation with BHC was practised and watered twice at an interval of 10 days with 0·1 per cent. methyl-demeton (Metasystox) soon after the shoots began to appear, no infestation or symptoms developed, whereas plants remaining in the nursery showed the characteristic injury. When plants were sprayed in the nursery with a systemic insecticide in mid-June, leaves developing thereafter remained free of mites and spotting for 3–4 weeks, after which infestation occurred. There was no interruption of infestation on unsprayed plants. In a test at Halle in 1957, heavily infested peach trees were sprayed twice, after the shoots began to appear, with 0·1 per cent. methyl-demeton. In June, symptoms could be seen only on the oldest leaves, and the tips were free from attack. Untreated control plants continued to show symptoms. No transmission of symptoms was effected by grafting, and it is concluded that the damage is due to feeding by the mite alone.

Klee (O.). **Über die Biologie und Saugtätigkeit des Thysanopteren** *Taeniothrips laricivorus* **Krat. und das Lärchenwipfelsterben.** [On the bionomics and feeding activity of *T. laricivorus* and the die-back of larch.] —*Waldhygiene* **2** no. 5–6 pp. 166–181, 13 figs., 61 refs. Würzburg, 1958.

The damage caused to European larch [*Larix decidua*] in Europe by *Taeniothrips laricivorus* Krat. & Farský has been recognised since 1911, although its insect origin was not understood until 1926 and the thrips was not described until 1941 [*R.A.E.*, A **31** 28; **32** 72]. Severe injury has occurred in western Germany since 1949. The life-history of the thrips is outlined [*cf.* **46** 66, etc.], its distinguishing characters are discussed, and it is pointed out that it is very close morphologically to *T. pini* (Uzel). The bionomics of *T. laricivorus* were studied in an area of heavily infested forest near the Neckar, in Baden-Württemberg, in 1953, to provide information on which control measures could be based. Vité's observation [**44** 207] that the females hibernate on spruce was confirmed, but the numbers found on that tree were much lower than those migrating from larch in autumn and appearing on it in spring. The spring migration of the overwintered females to larch, which was investigated by banding trees, placing sticky traps on 40-ft. poles round trees and just above the forest floor, and by direct observation from high platforms constructed both in the centre and at the edge of the forest, began about 21st April, four days after a long rainy period had been followed by warmer weather with maximum day temperatures of 18–20°C. [64·4–68°F.]. Feeding began immediately, and oviposition occurred shortly afterwards. During the migration, females were captured on the sticky traps on poles, but not on the other traps, indicating that migration is by flight. Other species of thrips taken are noted. The earliest first-instar nymphs were found on 1st May, and adults of both sexes of the first generation occurred at the end of June; adults of the second generation emerged in early August, after a shorter developmental period [*cf.* **41** 337]. Both nymphs and adults were strongly attracted to light, and this is thought to be a factor in the colonisation of larch shoots in spring. First- and second-instar nymphs and adult females crawled at speeds of 1, nearly 2 and about 5·5 in. per minute, respectively. The influence of weather on infestation was clearly evident. In 1952, a warm, humid spring was followed by a relatively hot, dry summer, which favoured the thrips but not larch growth. In 1953, there was a severe cold spell in late spring and, although temperatures rose slightly in July, rainfall was

about twice the normal; this favoured the growth of larch, but diminished the thrips population.

The mouthparts of *T. laricivorus* and the mode of feeding of the insect are described, and the various stages in the development of the injury to the tree are discussed. Initial damage to the cells by feeding, which is stated to occur at a rate of about 30,000 cells per insect in eight hours, causes silvering and spotting and is followed by curvature of the needles and injury to the axis of the shoot. The ultimate effect is a dying-back of the terminal shoots, to which the tree responds by regeneration from buds below the infested part, so that in time a witch's-broom proliferation develops and the tree no longer has a leading shoot.

Few natural enemies of the thrips are known, and the predacious *Aeolothrips* [*vittatus* Hal. (*cf.* **41** 337)] cannot be used for biological control, since it occurs only on low-growing plants. Tests on chemical control were carried out by enclosing infested larch shoots in sleeves, which were closed after sprays had been applied. The best results were given by mixtures of γ BHC with DDT, which provided high initial toxicity and a persistent effect; parathion and γ BHC alone gave high initial kills, but lacked persistence, and DDT was persistent, but did not give complete mortality. The most favourable time for treatment was about three weeks after the appearance of the overwintered females, with a second application two weeks later to control the immature stages. The cost and the difficulty of applying insecticides make the use of silvicultural methods preferable, and it is suggested that the more resistant Japanese larch [*L. leptolepis*] or possibly hybrids of it with *L. decidua* should be used for planting in infested areas.

Ohnesorge (B.). **Untersuchungen über die Populationsdynamik der Kleinen Fichtenblattwespe, *Pristiphora abietina* (Christ) (Hym. Tenthr.). I. Teil. Fertilität und Mortalität.** [Investigations on the population dynamics of *P. abietina*. Part I. Fertility and mortality.]—*Z. angew. Ent.* **40** pt. 4 pp. 443–493, 5 figs., 22 refs. Hamburg, 1957. (With a summary in English.)

Outbreaks of *Pristiphora abietina* (Christ) on spruce in Germany are long-lasting [*cf. R.A.E.*, A **31** 76], so that in many places this sawfly constitutes a permanent pest. Investigations were carried out in 1952–55 on the factors affecting its population density, mainly at Cloppenburg (near Oldenburg), but also near Brunswick and by examination of cocoons collected in November 1954 from Walsrode (to the south-east of Bremen), Münster and southern Denmark. The results concerning fertility and mortality are here reported, and the following is based partly on the author's summary of them.

Adults at Cloppenburg suffered little mortality from predators, but prolonged cold, wet weather in May 1955 reduced the numbers of eggs laid by about 80 per cent. Short periods with low temperatures are, however, not injurious. The number of eggs laid appeared to be about 40–70 per female, probably did not exceed 100 in any area, and decreased somewhat in the later years. Unmated females oviposited, giving rise to males. Owing to the short duration of the egg stage and the sheltered position of the eggs in the shoots, egg mortality was low.

Larval mortality was 50–70 per cent. at Cloppenburg in the summer of 1954, and ants (*Formica rufa* L.) were responsible for much of it. Rain and storms caused many larvae to fall from the trees, but some of them were able to return or to spin cocoons and continue development. Mortality increased with the age of the shoots, and larvae that fed on old ones mostly

died before or just after spinning cocoons. Cocoon stages were present in the soil from at least June until April, and some individuals (5·3–28·5 per cent. of the population at Cloppenburg) remained in the soil for a further period. Mortality of the cocoon stages was 83–90 per cent. Examination of empty cocoons showed that 47–72·5 per cent. of them had been opened by predators, mostly Elaterids, of which *Athous subfuscus* (Müller) comprised 80 per cent. Some of those attacked by predators had also been parasitised, and a further 6·5–24 per cent. had been attacked by parasites alone. Examination of full cocoons in two localities at Cloppenburg showed that parasitism was 41 and 19 per cent., respectively, in the late summer of 1952, rising to 51·5 and 47 per cent. in that of 1955. Up to 60 per cent. of full cocoons were infected by fungi, or had dried out, by the spring of each year. Of the parasites obtained from cocoons collected in spring, 40–60 per cent. were usually *Polyblastus* (*Scopiorus*) *flavicauda* (Roman), 10–20 per cent. *Eclytus exornatus* (Grav.), 0–10 per cent. *Ichneutes reunitor* Nees, 3–24 per cent. *Endasys* (*Stylocryptus*) *erythrogaster* (Grav.), 0–20 per cent. *Aptesis* (*Microcryptus*) *galactina* (Grav.) and 0–15 per cent. probably *Tritneptis klugii* (Ratz.). The cocoons of males were more heavily parasitised than those of females, owing to coincidence with larval parasites or because males, being nearer the surface of the litter than females, are more accessible to parasites. Females comprised, in general, about 60–70 per cent. of all adults.

Weiser (J.). **Mikrosporidien des Schwammspinners und Goldafters.** [Microsporidia of *Lymantria dispar* and *Euproctis chrysorrhoea*.]—*Z. angew. Ent.* **40** pt. 4 pp. 509–521, 6 figs., 10 refs. Hamburg, 1957. (With a summary in English.)

In 1957, two Microsporidia, *Nosema lymantriae* and *N. muscularis*, were isolated from third-instar larvae of *Lymantria dispar* (L.) on oak in central Czechoslovakia and one, *Thelohania similis*, from larvae of *Euproctis chrysorrhoea* (L.) (*Nygmia phaeorrhoea* (Don.)) on fruit trees near Bratislava. The organisms and the infections caused are described. In the laboratory, mortality from infection by *Nosema muscularis* and *T. similis* began after five days and was complete in about 30 days, depending on the severity of infection and, in the case of *T. similis*, on the larval instar. That from infection by *N. lymantriae* did not occur in many cases until after 30 days. *N. muscularis* was also pathogenic for *E. chrysorrhoea* and *Hyphantria cunea* (Dru.), and *T. similis* for *L. dispar* and *Stilpnotia salicis* (L.). *N. lymantriae* did not by itself infect *E. chrysorrhoea*, but when a combination of all three Microsporidia was established in *L. dispar*, all of them could be transmitted from the latter to *E. chrysorrhoea*.

Herting (B.). *Myxexoristops hertingi* **Mesn., die Tachine der Kiefernschonungsgespinstblattwespe** (*Acantholyda erythrocephala* **L.**). [*M. hertingi*, the Tachinid parasite of *A. erythrocephala*.]—*Z. angew. Ent.* **40** pt. 4 pp. 576–578, 1 fig., 5 refs. Hamburg, 1957. (With a summary in English.)

The Tachinid, *Myxexoristops hertingi* Mesnil, is recorded as a common parasite of *Acantholyda erythrocephala* (L.) (a pine sawfly) in Germany, where it was found in the district of Schneidemühl in 1940 and in Westphalia in 1951. It had previously been misidentified.

Hůrka (K.). **Experimentaluntersuchungen über die Ökologie der Maikäferengerlinge** (*Melolontha hippocastani* **F.).** [Experimental investigations on the ecology of the larvae of *M. hippocastani.*]—*Z. angew. Ent.* **41** pt. 1 pp. 1–16, 5 graphs, 17 refs. Hamburg, 1957. (With a summary in English.)

The following is based mainly on the author's summary. Laboratory investigations on first- and second-instar larvae of *Melolontha hippocastani* F. and *M. melolontha* (L.) dug from the soil near Prague showed that the ascent of the overwintered larvae in spring depends primarily on soil temperature [*cf. R.A.E.*, A **31** 450] and is completed earlier by those of the second instar than by those of the first, but that if the larvae encounter food during the ascent [*cf.* **30** 332], they continue to ascend only after feeding. Third-instar larvae of *M. hippocastani* fed as soon as they resumed activity, so that they may be expected to maintain or increase their body weight during the ascent and during cold spells in the vegetative period. They showed an increase in weight of 17–18 per cent. over a period of 40 days during which the temperature was mostly below 10°C. [50°F.], and food consumption was greatest in the first few days after hibernation. Loss in weight due to loss of water in a dry environment was greater at the higher temperatures, and the relative humidity associated with minimum loss of weight of third-instar larvae of *M. hippocastani* was 100 per cent. at 13 or 14°C. [55·4 or 57·2°F.] (normal soil temperature) and 96 per cent. at about 20 or 22°C. [68 or 71·6°F.]. There is a natural decline in the water content of larvae entering hibernation, and the loss of weight lethal to such larvae was 47–48 per cent., as compared with 56–61 per cent. for those about to pupate. The larvae survived a very high concentration of carbon dioxide in the soil in spring for at least 10 days at 13°C., and for some 4–5 days at 20°C.

Schefer-Immel (V.). **Eine neue** *Megastigmus***-Art,** *Megastigmus zwölferi* **nov. spec. (Hymenoptera, Chalcididae) als Samenstörer von** *Pinus strobus*. [A new species of *Megastigmus*, *M. zwölferi*, sp.n., destroying seeds of *Pinus strobus.*]—*Z. angew. Ent.* **41** pt. 1 pp. 52–57, 8 figs., 12 refs. Hamburg, 1957. (With a summary in English.)

Megastigmus zwölferi, sp. n., is described from adults of both sexes reared from larvae found damaging the seeds of Weymouth pine (*Pinus strobus*) near Beerfelden, in the Odenwald district of Germany, in 1955. Its relation to other species of the genus is discussed.

Meltzer (J.). **Insektizide und akarizide Wirksamkeit von 2,4,5,4′-Tetrachlor-Diphenyl-Sulphon (Tedion).** [Insecticidal and acaricidal efficacy of 2,4,5,4′-tetrachlorodiphenyl sulphone (Tedion).]—*Z. angew. Ent.* **41** pt. 1 pp. 58–63, 3 refs. Hamburg, 1957. (With a summary in English.)

Tedion was shown in earlier tests by the author to be effective against eggs and larvae (though not adults) of *Tetranychus telarius* (L.) (*urticae* Koch) [*cf. R.A.E.*, A **47** 319, etc.], and the results already obtained with this and other organic sulphur compounds are summarised in a table. In further tests, Tedion at a concentration of 100 parts per million gave 99 per cent. mortality of dipped eggs of *Panonychus* (*Metatetranychus*) *ulmi* (Koch), and, at a concentration of 10–100 p.p.m., the dried deposits gave 99–100 per cent. mortality of eggs of this mite placed on them. It did not, however, have any effect on seven representative species of insects on which it was tested

as a contact or stomach poison or both, from which it is concluded that it would probably have no effect on insect predators or parasites of Tetranychids. Bees were not affected by very high concentrations in contact and stomach-poison tests.

MÜLLER (O.). **Biologische Studien über den frühen Kastanienwickler *Pammene juliana* (Stephens) (Lep. Tortricidae) und seine wirtschaftliche Bedeutung für den Kanton Tessin.** [Biological studies on *P. fasciana* and its importance for the canton of Ticino.]—*Z. angew. Ent.* **41** pt. 1 pp. 73–111, 25 figs., 19 refs. Hamburg, 1957. (With a summary in English.)

Chestnuts (*Castanea sativa*) in the Swiss canton of Ticino are commonly infested by *Cydia* (*Laspeyresia*) *splendana* (Hb.) and *Curculio* (*Balaninus*) *elephas* (Gyllh.), and considerable losses have also been caused of recent years in some districts by *Pammene fasciana* (L.) (*juliana* (Steph.)), which is less well known. The principal differences in the morphology and bionomics of these three insects are shown in tables. Adults of *Cydia* emerge in August–September and oviposit on the leaves, and the larvae feed in the chestnuts until about early October and then spin cocoons in the litter or upper soil layer, where they remain until they pupate at about the beginning of the following August. Adults of *Curculio* emerge in September–October and oviposit in the chestnuts, and the larvae feed in the latter until about the beginning of November, after which they enter the soil to a depth of 8–20 in., pupating about mid-August of the following year. Examination of picked and fallen chestnuts in 1955 showed that *Cydia* occurred in all of 116 localities and *Curculio* in all but a few of them, and indicated infestation of up to 78 and 52 per cent. by the two insects, respectively. *Pammene*, the distribution of which is shown on a map, was commonest in the Lugano district, and infestation by it ranged up to 45 per cent., equalling or exceeding that by *Cydia* in a few places.

The synonymy of *P. fasciana* is discussed, all stages are described, and an account is given of investigations on its bionomics, carried out in 1952–56. The adults emerged between early June and August, mostly between mid-June and mid-July, and the ratio of males to females was 3:2 at light and 1:1 in emergence tests. Mated females lived for 10–12 days, laying an average of 180 and a maximum of 336 eggs each, mainly on the leaves but sometimes on or at the base of the cupules. In the laboratory, they oviposited only at temperatures above 15°C. [59°F.]. Eggs and larvae developed at temperatures above 11°C. [51·8°F.]. The larvae hatched about mid-June and fed at first on the leaves or at the base of a cupule, but all shortly penetrated the cupules and fed (except for late-hatching ones) on the still immature kernels, causing the cupules to wither and fall in July–August. One larva attacked several cupules if they were small. Full-fed larvae moved to the trunks of the trees between the end of July and the beginning of November, most of them in the second half of August, whether they came from fallen cupules or those on the tree, and spun cocoons on the bark. They overwintered in these and pupated towards the middle of the following June, the pupae developing at temperatures above 9°C. [48·2°F.]. In the laboratory at 70–80 per cent. relative humidity, the minimum duration of egg development with 100 per cent. survival was 9 days (at 20·5°C. [68·9°F.]), and that of larval and pupal development 27·5 and 14 days, respectively (both at 25°C. [77°F.]). The larvae were attacked by 12 species of parasite, of which the most numerous were the Ichneumonids, *Hemiteles inimicus* Grav., *H. areator* (Panz.), *Lissonota buolianae* Htg. and *Trichomma*

enecator (Rossi). The first three develop as far as the larval stage while the host larva is in the earlier part of its winter diapause, and overwinter, and the adults emerge from the host larvae at about the end of May or beginning of June. *Trichomma* differs in that the adults emerge from the host pupae. The percentage parasitism ranged from 9 to 55 and averaged 27.

Sprays containing DDT, diazinon or malathion are recommended for control of the young larvae, and trap bands for control of the overwintering ones on smooth trunks. Some control of larvae seeking overwintering sites was obtained by spraying the bark with an emulsified solution of BHC. When newly hatched larvae were placed on leaves treated with a suspension of *Bacillus thuringiensis* that had been allowed to dry, mortality was complete after four days.

Horber (E.). **Erhöhte Vorsicht bei der chemischen Maikäferbekämpfung zwecks Vermeidung von Insektizidrückständen in Grünfutter und Milch!** [Need for increased care in the chemical control of cockchafers to avoid insecticide residues in green fodder and milk.]—*Mitt. schweiz. Landw.* **7** no. 10 pp. 151–157, 13 refs. Frauenfeld, 1959.

The edges of woodland are treated with insecticides for the control of adults of *Melolontha melolontha* (L.) in late April or early May in Switzerland [*cf. R.A.E.*, A **44** 102], and there is a danger that accidental deposits on neighbouring grassland may lead to contamination of the milk of cattle grazing on it. In investigations in 1958, 4 parts γ BHC per million was found on grass growing close to the edge of woodland sprayed with BHC from mistblowers or aircraft a day and a half previously, and an average of 2 p.p.m., with a range of up to 10 p.p.m., on grass sprayed earlier. Milk from cattle grazing in the area showed 0·15 p.p.m. γ BHC three days after the treatment, 0·05 p.p.m. 11 days after it, and none not until after a further week, and was therefore unfit for human consumption for 18 days. As a precaution, the grass should be mown for a distance of about 50 yards from the edge before woodland is treated, or not used for grazing dairy cattle. A dye added to the spray will serve as a useful warning of contamination.

Papers noticed by Title only.

Minamikawa (J.). **A list of the tea injurious insects in Japan** [including also mites]. [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 149–154, 4 refs. Kyoto, 1957.

Tanaka (T.). **Taxonomy and distribution of some subterranean aphids injurious to the upland-rice in Japan with description** [in English] **of a new species** [*Forda harukawai*]. [*In Japanese.*]—*Botyu-Kagaku* **22** no. 1 pp. 168–176, 5 figs., 25 refs. Kyoto, 1957. (With a summary in English.)

Muesebeck (C. F. W.) & Subba Rao (B. R.). **A new Braconid parasite** [*Apanteles delhiensis*, sp.n.] **of** *Hymenia recurvalis* **(Fabricius)** [reared at New Delhi].—*Indian J. Ent.* **20** pt. 1 pp. 27–28, 4 figs. New Delhi, 1958.

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NOTICES

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